ANNUAL REPORT

1952-1953 **Bul. 475**

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MASSACHUSETTS
AMHERST

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION

Trustee Committee on Agriculture and Horticulture

	Term Expires
BRETT, BOSTON C., Belmont, *Chairman*	1957
BRODERICK, HENRY T., *Commissioner of Agriculture*	
BROWN, HARRY DUNLAP, Billerica	1954
HOFTYZER, ERNEST, Wellesley	1957
CROWLEY, DENIS M., Boston	1959

Experiment Station Staff, June 30, 1953

VAN METER, RALPH A., *President of the University*

SIELING, DALE H., Director
BLAISDELL, MATTHEW L., Superintendent of Farms and Head of Station Service
O'DONNELL, MARGARET H., Administrative Director
CROSS, CHESTER E., Head, Cranberry Station
KOON, RAY M., Head, Waltham Field Station
JOHNSON, KENNETH W., Treasurer
KINSMAN, DONALD M., Assistant to Superintendent of Farms
IERARDI, PORTIA A., Editor
ROSE, DOROTHY M., Secretary

*ALEXANDER, CHARLES P., Entomology
ARCHIBALD, JOHN G., Animal Husbandry
BENNETT, EMMETT, Chemistry
BOURNE, ARTHUR I., Entomology
BROWN, ALFRED A., Agricultural Economics and Farm Management
*BULLIS, KENNETH L., Veterinary Science
†CHANDLER, FREDERICK B., Cranberry Station
*COLBY, WILLIAM G., Agronomy
DORAN, WILLIAM L., Botany
DRAKE, MACK, Chemistry
ESSELEN, WILLIAM B., Jr., Food Technology
‡FADDOUL, GEORGE P., Veterinary Science
*FELLERS, CARL R., Food Technology
*FRANCE, RALPH, Bacteriology
*FRENCH, ARTHUR P., Pomology
FULLER, JAMES E., Bacteriology
*GAMBLE, PHILIP L., Economics
GRAY, JACK, Veterinary Science
‡GUBA, EMIL F., Botany
*HANKINSON, DENZEL J., Dairy Industry
HARRIS, WILLIAM K., Veterinary Science
HAYS, FRANK A., Poultry Husbandry
HITCHNER, Stephen B., Veterinary Science
*HOLDSWORTH, ROBERT P., Forestry
HOLMES, ARTHUR D., Chemistry
*JEFFREY, FRED P., Poultry Husbandry
KIGHTLINGER, CLIFFORD V., Agronomy
*KOZLOWSKI, THEODORE T., Botany
*KUZMESKI, JOHN W., Dairy, Feed and Fertilizer Control
*LINDSEY, ADRIAN H., Agricultural Economics and Farm Management
*MCKENZIE, MALCOLM A., Shade Tree Laboratories
MITCHELL, HELEN S., *Dean*, Home Economics.
*OTTO, RAYMOND H., Landscape Architecture
*RICE, VICTOR A., Animal Husbandry
*RITCHIE, WALTER S., Chemistry
ROZMAN, DAVID, Economics
SNOEYENBOS, GLENN H., Veterinary Science
*SNYDER, GRANT B., Olericulture
SOUTHWICK, FRANKLIN W., Pomology
*STAPLETON, HERBERT N., Agricultural Engineering
STECKEL, JOSEPH, Agronomy
*THAYER, CLARK L., Floriculture
VAN ROEKEL, HENRY, Veterinary Science
*WERTZ, ANNE W., Home Economics Nutrition
‡WHITCOMB, WARREN D., Entomology
WHITE, HAROLD E., Floriculture

†BAILEY, JOHN S., Pomology
CROSSMON, BRADFORD D., Agricultural Economics and Farm Management
LACHMAN, WILLIAM H., Jr., Olericulture
*MCLAUGHLIN, FREDERICK A., Seed Control
MUELLER, WILLIAM S., Dairy Industry
PFLUG, IRVING J., Agricultural Engineering
SMITH, C. TYSON, Feed and Fertilizer Control
SPELMAN, ALBERT F., Feed and Fertilizer Control
†TOMLINSON, WILLIAM E., Jr., Cranberry Station
‡YOUNG, ROBERT E., Olericulture

ANDERSON, EDWARD E., Food Technology
ANDERSON, JESSIE E., Seed Control
BECKER, WILLIAM B., Entomology
CLARKE, MIRIAM K., Veterinary Science
§CROWLEY, LEO V., Feed and Fertilizer Control
FAGERSON, IRVING, Food Technology
FITZPATRICK, ROBERT A., Agricultural Economics and Farm Management
GASIORKIEWICZ, EUGENE, Botany
GERSTEN, BERTRAM, Feed and Fertilizer Control
GRAY, JOSEPH, Veterinary Science
JONES, LINUS H., Botany
KUCINSKI, KAROL J., Agronomy
LITSKY, WARREN, Bacteriology
LOIKIN, MARY, Home Economics Nutrition
MARSDEN, DAVID H., Shade Tree Laboratories
MASTALERZ, JOHN W., Floriculture
**OLESIUK, OLGA M., Veterinary Science
PARKINSON, LEONARD, Food Technology
‡RUSDEN, PHILIP L., Shade Tree Laboratories
SMYTH, J. ROBERT, Poultry Husbandry
SPINDLER, HERBERT G., Agricultural Economics and Farm Management
STADTHERR, RICHARD J., Landscape Architecture
VENGRIS, JONAS, Agronomy
WETHERBEE, ROBERT T., Feed and Fertilizer Control

BART, JOSEPH A., Feed and Fertilizer Control
BENINATO, LEO C., Veterinary Science
BENNETT, ROBERT, Veterinary Science
‡BOBULA, PAUL, Landscape Architecture
§BRANDT, CARL D., Veterinary Science
†CAMPBELL, FRANKLIN, Floriculture

CHATER, CLIFFORD S., Shade Tree Laboratories
‡FELLOWS, GORDON W., Veterinary Science
FOX, THOMAS, Poultry Husbandry
‡GARLAND, WILLIAM, Entomology
GUILD, LOUISE P., Home Economics Nutrition
JARVESOO, ELMAR, Agricultural Economics and Farm Management
MURPHY, GLADYS HAGEN, Home Economics and Farm Management
REISING, GILBERT, Jr., Veterinary Science
REYNOLDS, IONA M., Veterinary Science
SHERBURNE, RUTH E., Economics
SMYSER, CHARLES F., Jr., Veterinary Science
WEEKS, WALTER D., Pomology
YEGIAN, HRANT M., Agronomy

AINES, RONALD O., Agricultural Economics and Farm Management
BARONOSKI, DOMENKA, Veterinary Science
BRISTOL, CECELIA, Veterinary Science
CORMIER, RAYMOND, Veterinary Science
CROSBY, EARLE, Veterinary Science
HART, MARY M., Shade Tree Laboratories
JONES, GERTRUDE R., Veterinary Science
LAMBERT, DORIS, Veterinary Science
LAMBSON, FRANK, Veterinary Science
LEIPZIGER, MARY A., Veterinary Science
LINCOLN, WALDO C., Jr., Seed Control
‡LINSE, JOSEPH, Horticulture
MERWIN, CHARLES L., Veterinary Science
MIENTKA, MARGARET, Veterinary Science
MOLINE, JESSIE, Shade Tree Laboratories
MUSANTE, LOUIS, Veterinary Science
‡PASQUALONE, RICHARD, Waltham Field Sta.
PETERSEN, CARL, Veterinary Science
PIERCE, VIRGINIA, Agricultural Economics and Farm Management
‡SMITH, ROBERT, Entomology
STANLEY, ALBERT M., Veterinary Science
TURNER, THELMA, Veterinary Science
UPTON, GRACE, Pomology
WHITE, W. HENRY, Botany

•In charge †At East Wareham ‡At Waltham §On Military Leave **On Leave

CONTENTS

FINANCIAL STATEMENT, 1952-53, UNIVERSITY OF MASSACHUSETTS, AGRICULTURAL EXPERIMENT STATION

	Hatch	Adams	Purnell	Bankhead-Jones 5	Bankhead-Jones 9b1-2	Bankhead Jones 9b3	Research & Mkt. Title II	Non-Federal Funds	Total
RECIPTS									
Received from U. S. Treasury	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$41,538.49	$12,450.00	$4,000.00		$184,686.68
State appropriation								$458,050.36	$458,050.36
Special industry								31,840.85	31,840.85
Balance forward								27,552.05	27,552.05
Total Receipts	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$41,538.49	$12,450.00	$4,000.00	$517,443.26	$702,129.94
DISBURSEMENTS									
Personal service	8,970.00	15,000.00	51,225.58	30,632.68	27,160.34	7,066.25	2,931.82	441,565.37	584,552.04
Travel	404.09		1,381.20	376.42	2,170.95	945.86	157.67	7,841.68	13,277.87
Transportation of things	7.12		196.76	35.61	37.68			757.85	1,035.02
Communication service					10.00			4,985.33	4,995.33
Rents and Utility services			36.75		7.92			497.18	541.85
Printing	258.25					874.60		3,978.17	5,111.02
Contractual services	553.60		87.67	93.30	585.41	3,000.00		4,863.49	9,183.47
Supplies and materials	803.30		4,433.21	3,111.32	8,265.13	124.37		25,491.20	42,228.53
Equipment	4,003.64		2,638.83	2,448.86	3,301.06	400.52		3,809.51	16,602.42
Balance forward							910.51	23,653.48	24,563.99
Total Disbursements	$15,000.00	$15,000.00	$60,000.00	$36,698.19	$41,538.49	$12,411.60*	$4,000.00	$517,443.26	$702,091.54
									38.40*
									$702,129.94

*$38.40 unexpended and returned to U. S. Treasury.

DEPARTMENT OF AGRICULTURAL ECONOMICS AND FARM MANAGEMENT

A. H. LINDSEY IN CHARGE

Farm-to-Market Bulk Milk Handling. Tank holding and cooling of milk on farms and tank transportation of such milk to city plants have begun to take the place of conventional coolers and the can method of handling and transporting milk.

The system involves a higher investment by the farmer. The stainless steel tanks and cooling units cost as much as $1,000 depending on their size. The hauler measures and weighs the milk at the farm and uses a tank–truck for farm-to-market hauling. Every–other–day pick-up is being tried. If both methods of handling are used, route duplication and the receiving of milk in both cans and in tanks require two types of receiving equipment. If only bulk handling is used, the weigh tank, receiving crew, and the can washer may be eliminated, and the space used for other operations.

The new system appears to be feasible in areas where producers market fifteen 40-quart cans or more a day. However, production per farm in Massachusetts averages only about four cans a day. Data need to be assembled and presented in an organized manner so that estimates of costs of the two systems can be compared.

From basic data obtained from representatives of dairy equipment concerns, milk dealers, and available market statistics, some cost figures for the tank depreciation and interest were computed for various size producers. This indicates that a 2-can producer would have a cost of 19 cents per hundredweight; a 4-can (average) producer, a cost of 11.5 cents per hundredweight; an 8-can producer, 7.7 cents per hundredweight; and a 16-can producer, 5.5 cents per hundredweight. On every–other–day pick-up, larger tanks increase costs 3.8 cents for the 2-can producer, 3.7 cents for the 4-can producer, 3.3 cents for the 8-can producer, and 1.7 cents for the 16-can producer.

—H. G. Spindler and A. H. Lindsey.

Intermarket Milk Price Relationships and Supply Areas. The study of price relationships between markets and the relationships between fluid, producer, and manufacturing milk prices is now in a rough draft stage. Its major purpose is to analyze price relationships between markets, as well as some of the reactions to varying levels of price differences, so that the economic reactions and effects of different levels or prices may be better understood. Determination of prices on a location theory basis provides a standard for intermarket pricing of milk.

Since the Class I price is the only milk price on which there is a substantial degree of leeway in price level determination, an attempt was made to analyze some of the effects of various levels of Class I price on the proportion of Class I in the pool and on the composite price paid to producers.

It was found that price pressures and price inequalities both to producers and dealers and between secondary markets and Boston tend to increase when the Class I prices are higher than normal, and the difference in producer prices between markets also appears to increase with wider ranges between Class I and Class II.

With minor exceptions, the actual supply areas conform approximately with the outline of theoretical milkshed supply areas developed on a location theory basis. However, in periods of high Class I prices, (relative to Class II prices) large quantities of surplus milk result which, in turn, through price pressures, etc., result in substantial quantities of Class II. From the viewpoint of minimization of transportation and mannfacturing costs, Class II should not persist in a fluid area.

On price differences, there was a general direct relationship of increase in prices at markets and farms to distance from surplus supply areas. The differences however, were oftentimes substantially above the amount that could be accounted for by transportation alone. A number of other factors, such as fluctuation in seasonal demand, bargaining power of cooperatives, differences in evenness of production, and lag factor in making adjustments, account for the difference not attributable to transportation.

—H. G. Spindler, Virginia Pierce, and Carol Martin.

Delivery Labor Cost on Milk Routes. Detailed data through route schedules and personal contact were obtained from eight large and medium-sized Springfield milk dealers including 17 retail and 13 wholesale delivery routes. The data include the delivery labor cost, the hours worked, and the units delivered for the week ending April 26, 1952. The basic purpose is to analyze some of the major factors affecting the largest single cost item in the dealers' spread, namely, the routemen's wage.

Studies have indicated that dealers' profit on a quart of milk generally averages only a few tenths of a cent a quart. Therefore, the spread between the producer price and the price to the consumer can only be reduced through reductions in dealers' processing and distribution costs.

Analysis of the sample of 17 retail routes covering approximately 5 percent of the market area sales in Springfield indicates that the average route distance is 26.1 miles a day. There were 184 customers served per route; 14 of the 17 routes deliver to customers three days each week, and 3 of the routes were delivering every other day. There were 5.6 truck stops per mile, and 7.1 customers served for each mile traveled. Units delivered averaged 3.6 per truck stop and 2.8 per customer.

The salary for a work-week of 44.9 hours averaged $78.39 for the regular route driver. The addition of the relief driver, etc. brought the weekly route wage cost to $95.70. The wage cost per unit (generally one quart) averaged $0.03.

The average value per unit delivered was $0.252 and the average value per hour was $14.84 with an average value per mile of $5.03. The average value per customer per day was $0.71.

Further analysis is being made of relationships between time and costs per unit delivered with number of units per customer, number of miles traveled, number of second- and third-floor customers, size of load carried, etc.

—H. G. Spindler, A. A. Brown, C. Martin, and M. Vander Pol.

The Structure and Relationship of Freight Rates on Feed to Poultry Feed Prices in the East. Feed, so far as the railroads are concerned, is feed. To the carriers, it makes little difference whether cows, horses, or chickens are the intermediate or ultimate consumers. In the tariffs the item appears as "Feed, Animal or Poultry." From points in Indiana and Illinois to those along the seaboard north of Norfolk the grain rate applies.

The rate on much of the feed used in New England in 1952 was approximately $0.70 per hundredweight. The estimate is based on the rates published in the tariffs and on a realization that much of the basic ingredients in feed must come from the Midwest and that a limited opportunity exists for buying ingredients on terms reflecting lower rates from some Canadian or nearer domestic origins.

The rate structure is characterized by extensive blanketing in both origin and destination territory; that is, communities are grouped, and the group is one for rate purposes. With the exception of northern Maine, for instance, all New England takes what is known as the Boston rate. In Indiana and Illinois, the groupings are known by so-called index numbers, which originally were percentages derived from group distances as related to the Chicago–New York distances.

Two elements of considerable importance in understanding freight rates on feed are 1) the method of pricing ingredients and 2) the privilege of transiting. Corn, oats, millfeeds, etc. are sold to feed mixers on a destination basis. The practice places on the seller the responsibility of meeting market prices. Assuming that responsibility, the seller, i.e. the shipper in Buffalo, Toledo, Cincinnati, Chicago, etc., includes freight rates in his prices. Consequently, rates or at least rate knowledge was only of minimum interest to the ultimate user. Transiting on the other hand was extremely important. The feed mixer in New England or New York had to be able to bring his ingredients to the mill, process and combine them, and move them out under rates that did not place him at a disadvantage relative to mills in origin territory. For a small fee of $0.0089, less than a cent a hundredweight in 1952, he was able to do this and to send the tonnage on at the through rates, i.e., the same rate that a miller in Illinois might have paid to such a place as Amherst.

Measured in terms of services received, freight rates on feed do not appear to be excessive. As a cost item about which feed buyers can do little and which on a $5.00 per hundredweight feed price amounts to 14 percent, the rate cannot be ignored. As one factor in computing revenues from grain tonnage, the adequacy of the rate becomes more difficult to evaluate.

—A. A. Brown.

Production Adjustments on Representative Massachusetts Farms. Current operating statements were developed for cooperating dairy

case farms in Hampden and Worcester Counties. Prices and costs of an earlier period were used in preparing the budgets. Thus, the effects of changes in organization and in technological practices on cooperating farms over a five-year period could be seen in terms of a common dollar. The majority of the farmers made substantial progress in the direction jointly planned five years ago.

Costs and returns are being determined for various systems of forage production and utilization on major types of dairy farms.

Thirty-five to forty carefully selected Massachusetts fruit farms are being studied currently. These case studies have been selected as basically representative of eight different-sized fruit farm organizations. The eight different-sized groups range from the small part-time or diversified farm of less than two hundred apple trees to the large specialized apple farm of over 6,000 trees. The Massachusetts Fruit Growers' Association survey of 1950 together with the 1950 Census was used as a basis for determining these groups.

Using these case studies as a basis, the effect on the over-all organization and income of changes in technology and prices can be projected. The additional costs and returns of particular adjustments will be presented. In addition, complete operating statements will be established for these selected Massachusetts apple farms. Such financial statements should be of real assistance to the farmer in making the management decisions which confront him daily.

Poultry adjustments receiving current study concern a shift to lighter breeds or Leghorn-Red crosses and the holding of laying birds for a second year.

Material has been prepared to show the effect of changing outlook on poultry farm adjustments.

Economic aspects of overhead sprinkler systems on cranberry bogs are being studied. Growers surveyed indicated that such systems use less water for frost protection and have possibilities for spraying insecticides and fertilizers. Investments for semipermanent overhead systems with multipurpose complete coverage are much more costly than portable systems that irrigate only a small acreage at a time.

—B. D. Crossmon and Ronald O. Aines.

Marketing of Hatching Eggs. Chemists in three years have done more to influence broiler-hatching egg production on Massachusetts farms than others have accomplished in 30 years. In one sense, the work of chemists has undone in a short time the results of a lifetime devoted to breed and strain development.

Such innovations as plastics and the marketing of cut-up chicken have brought about a rapid shift in the make-up of breeding flocks, especially those kept for the production of broiler-hatching eggs.

On the basis of data accumulated in connection with the pullorum disease control program, it appears that two significant changes have occurred since April, 1950, in Massachusetts flocks kept for broiler-hatching egg production: a decrease in the total number of birds kept and a shift in the relative importance of the several breeds.

The total number of birds kept[1] for broiler-hatching eggs dropped

[1] Females—maximum; not necessarily for broiler-hatching only, but suitable.

22.5 percent from 1950 to 1951 through 1952-53. Broiler-cross matings were down 72 percent, even though dominant whites, which skyrocketed from almost nothing to nearly 5 percent of the total were included as one of the crosses. Straight matings increased 36.3 percent.

The abruptness of these changes and their impact on the Massachusetts poultry industry intensify the need for developing data that will enable poultrymen and allied groups to evaluate the significance of adjustments. Some, perhaps much, of the basic data needed to make such an evaluation are part of the record maintained by the Pullorum Disease Control Laboratory on Massachusetts breeding flocks. From these records the number of layers going into flocks (by breeds and possible matings) can be computed as of a date as well as the accumulated aggregate from the beginning of the test year. Additions in a current year to laying capacity obviously represent perhaps only part of the supply. Birds on hand must be included too and properly accounted for. The adjustments are influenced by flock management practices, which vary noticeably. Chicks are started in every month of the year. Culling rates differ. To these elements must be added a factor for losses caused by disease and other natural hazards.

Analysis of the data on tested flocks indicated the possibility of developing a "production year" for the various flocks; this year begins with the month in which each flock is tested. Records taken as part of a previous study of marketing practices provided data on losses and culling rates. The test data were adjusted for these items. The balances, when added each month, became the flock capacity as of that month.

The procedure is not unlike that used in arriving at a moving monthly average except that we are concerned with monthly totals rather than monthly averages. Flocks were assumed to be liquidated twelve months after the test month.

A comparison was made between the average weekly production on Massachusetts farms (using a rate of one case of eggs per 100 birds per week) and eggs set in the Del-Mar-Va area as reported by the Crop Reporting Service of the USDA. In the short period for which comparisons were possible, with the exception of one brief period in the Spring of 1951, the curves moved together with sufficient consistency to warrant continuing with efforts to develop greater precision.

—A. A. Brown and E. Jarvesoo.

DEPARTMENT OF AGRICULTURAL ENGINEERING

H. N. STAPLETON IN CHARGE

Animal Shelters and Farm Crop Storages.

Improvement of Poultry House Ventilation.

Evaluation of data investigating the location of fans and intake in poultry houses indicated that:

1. Little difference can be expected between dew point readings of the air on the north side and the south side of a building.
2. Solar radiation can increase the dry-bulb temperature on the south side of a building as much as 20 degrees more than on the north side.
3. For winter ventilation, air intake from the south side is more favorable for the control of critical heat and moisture balances.

—*H. N. Stapleton.*

Investigations to Improve Tobacco Curing.

The principal investigation concerned the comparison of kerosene (No. 1 fuel oil) with liquid petroleum fuel as a source of heat for curing stalk tobacco. The specific items investigated were: the temperature–relative humidity patterns for two barns; the adaptability of one type of commercially manufactured oil burning equipment; the suitability of kerosene as a curing fuel; and the comparative cost of using these fuels.

Results indicated that a greater number of low output burners provide more uniform heat distribution; that oil flow rates with this equipment could not be reduced low enough to maintain only small temperature differences on warm days; that the commercially available oil unit, designed for permanent installation, is high in initial cost, requires constant supervision, is inconvenient, and unsafe, under the conditions provided by Connecticut Valley barns and methods of operation; that no harmful results from oil as fuel are to be expected; that the quality of the cured leaf is about the same; and that the fuel cost is about one-half that with L-P gas. Considerable development is needed in commercial equipment to take advantage of this low cost fuel.

—*H. N. Stapleton and R. K. Patterson.*

Investigations on Mechanizing Cranberry Production. Field tests and redesign of the hydraulic ditch cleaner were continued. Both the priming means and the bucket inlet for the pump intake were found to be inadequate in field tests, and redevelopment of these parts was undertaken. Since use of the tractor engine as the prime mover for the pump interfered materially with satisfactory operation, auxiliary power for the pump and the priming means has been developed.

Data obtained from the nozzle tests have been studied, and suppliers of this equipment have been encouraged to undertake the development of devices that will increase the volume of delivery in particles of 100-micron diameter and less. Equipment currently available was found to be very wasteful of concentrated material because of the large percentage of total delivery contained in large particle sizes.

—*R. K. Patterson.*

Thermal Destruction of Bacterial Spores and Heat Labile Vitamins. A thermo-resistometer developed here for studying the thermal resistance of bacterial spores and heat labile nutrients has been applied to specific problems.

1. A comprehensive study was made to determine the thermal resistance of P. A. (Putrefactive Anaerobe) 3679 in neutral phosphate buffer solution. The results indicate that the thermal death time curve of this organism is a straight line over the temperature range 235 to 300°F. This observation is of particular significance and importance in evaluating the sterilizing value to be employed in the high temperature sterilization of foods.

2. In the analysis of thermal resistance data by accepted methods certain unexplainable trends often appear. A study was made using three spore concentration levels with 48 replicates at each time–temperature interval. The results of this test were studied in the light of the accepted statistical treatment and compared to a parallel study in which quantitative counts were made. The results led to the conclusion that bias in the method of treating the data could be responsible for the unexplained trends.

3. Parallel studies with the H. J. Heinz Co. to determine the effect of different laboratory techniques and apparatus on final results indicated that under controlled conditions results are comparable.

4. The thermal destruction of nutrients under high temperature processing conditions is more important because more food is processed by these methods. A study of the destruction rate of thiamine at 295°F. when suspended in neutral phosphate buffer indicated that the destruction rate curve of thiamine is a straight line when plotted on semilogarithmic paper.

—I. J. Pflug and W. B. Esselen.

Cooling Rates of Eviscerated Poultry. (See Department of Food Technology.)

—W. B. Esselen, I. J. Pflug and A. S. Levine.

DEPARTMENT OF AGRONOMY

W. G. COLBY IN CHARGE

The Chemical Composition of Weeds and Accompanying Crop Plants. The cumulative data for 1950 and 1951 indicated that some weeds have a strong feeding power for phosphorus. The objective for 1952 was to investigate the role and differences of various plants in the release of unavailable or "fixed" phosphorus in a soil.

Plots with corn alone, corn with weeds, and weeds alone were laid out with 200 pounds of N per acre, 150 pounds of K_2O per acre, and 0, 50, 100, and 200 pounds of P_2O_5 per acre. Yields of silage and P, K, Ca, Mg were determined. Corn grown alone did not show any yield response to different P rates. Corn with weeds responded only in plots with 200 pounds of P_2O_5 per acre as compared with the check plots. Even at a high fertility level, weeds left between corn plants competed for moisture as well as plant nutrients and on the average decreased the yield by 34 percent. Weeds alone (*Amaranthus retroflexus, Portulaca oleracea, Echinochloa crusgalli, Digitaria sanguinalis*) showed yield response to increased P_2O_5 rates.

Amaranthus retroflexus and *Portulaca oleracea* had the highest phosphorus content values. There was no difference in phosphorus content between corn grown alone and grown with weeds. *Echinochloa crusgalli* had the lowest P content.

Weeds left between corn plants competed very strongly for potassium and were thought to be responsible for the lower yields. Ca and Mg content in corn and dicotyledonous weeds dropped 30 to 50 percent with maturity, but *Echinochloa crusgalli* and *Digitaria sanguinalis* did not show any decrease in Ca and Mg with maturity. Both *Echinochloa crusgalli* and *Digitaria sanguinalis* were relatively high in Mg. Of all plants investigated corn had the narrowest ratio of Mg to P.

Weeds are very rich in minerals. At early maturity stage of growth, weeds contained three times as much cations as corn.

—*Jonas Vengris, Mack Drake and W. G. Colby.*

Control of Forage Crop Weeds in Massachusetts. The research work during 1952 included the following objectives:

1. Weed control in new seedings of grass–legume mixtures:

a. 2,4-D, MCP, and Dinitrophenols were applied. Dinitrophenols eliminated Shephard's Purse (*Capsella Bursa-pastoris*) 80 to 90 percent. In earlier applications (when nurse crop oats were 4 to 5 inches high) legumes were injured. When oats were 10 to 12 inches tall, no legume injury was observed. The legumes were slightly injured with the highest rate ½ pound acid equivalent per acre) of MCP and especially with 2,4-D.

b. Seeding rates and nurse crop rates in controlling weeds were investigated. Higher seeding rates as well as increased nurse crop rates decreased weed population. Preliminary data indicate that with the establishment of sods the differences between treatments tend to decrease.

2. Chickweed (*Stellaria media*) control in grass–legume mixtures:

a. Spring and fall seeding trials for 1952 showed that preplanting applications of calcium cyanamid eliminate this weed very

significantly. In general, the check plots consisted of 30 percent cultural plants and 70 percent weeds. On the treated plots, the percentages were approximately reversed.

The rates of calcium cyanamid as low as 400 pounds per acre are effective in controlling chickweed in grass–legume mixtures and alfalfa. Lightly mixing calcium cyanamid with the top 3– to 4–cm. of soil immediately after application facilitates the breakdown of this material and reduces the danger of injury to the new seeding.

b. Field plot trials showed that 1 to 2 pounds per acre of Dinitrophenols and 2 to 4 pounds per acre of CIPC applied late in the fall or early in the spring when alfalfa is dormant are promising in control of chickweed in established alfalfa sods.

3. Other objectives include:

a. Quackgrass (*Agropyron repens*) control.

b. Herbicides in the control of weedy grasses and other weeds in the renovation of old sods.

—*Jonas Vengris, W. G. Colby, and Mack Drake.*

Soil-Fertilizer Phosphorus Studies. Previous reports from this Station have indicated that fertilizer phosphorus is fixed by active iron and aluminum. In addition, the solubility of iron and aluminum phosphates was found to be greater in solutions containing iron and aluminum chelators, such as citrate and oxalate anions, which are produced extensively by soil microorganisms.

From this information a study was initiated to measure the effect of chelators on the solubility of rock phosphate. The laboratory investigations have shown that strong calcium chelators, such as citrate, ethylenediamine tetraacetate, and alkyl aryl sulfonate, will solubilize phosphorus from nine commercial samples including ground Florida land pebble, Tennessee brown, and colloidal phosphate rock.

The yields and phosphorus analyses of eleven yield years of forage crops, such as timothy, alfalfa, ladino–brome, and alfalfa–ladino–brome show 2000 pounds of rock phosphate to be equal to 1000 pounds of superphosphate. The combination treatment of 500 pounds of super and 1000 pounds of rock phosphate has produced equal yields and uptake of phosphorus when compared with treatment with 1000 pounds of superphosphate alone.

These data point to the importance of iron, aluminum, and calcium chelators in effecting the increased utilization of applied and native phosphorus.

—*Joe E. Steckel.*

Irrigation Studies and Management of Irrigated Soils. Tobacco irrigated three times and receiving three inches of irrigation water, produced higher yields of better quality tobacco than that which received the same amount of water in two applications. Too much water at one time may be harmful to tobacco and other crops as well.

Irrigated cabbage plots outyielded unirrigated plots. Check plots of cabbages produced unsalable "cracked heads" caused by an ab-

normally wet fall season after drought. No damaged heads due to cracking were found on the irrigated plots. These observations with cabbage are also applicable to tomatoes.

Irrigated onions produced greater yields and larger sized onions, which resulted in a better selling price than the nonirrigated onions.

Green Mountain potatoes, where irrigated, produced more large potatoes, which, however, were damaged by hollow heart. The increase in yield was about equal to the amount of culls produced.

Study of meterological data has indicated that about 9 out of 12 years the total consumption of water by plants and evaporation is considerably greater than the amount of water replenished by rainfall during the growing season. Supplemental irrigation should be considered by farmers not only as a crop insurance measure against drought but as one of the important farm management assurance practices.

— *Karol J. Kucinski.*

Farm Pond Investigations. Data were gathered on growth of largemouth bass and bluegill fingerlings stocked during 1950 and 1951 in ponds of Berkshire and Hampshire Counties. Fertilized farm ponds not exceeding 0.33 acre, produced 77 to 486 pounds per acre of largemouth black bass and bluegills grown to edible size. The average crop (258 pounds) reared in experimental ponds exceeds the production of fish from Massachusetts' natural ponds and reservoirs. Stocked largemouth bass grow rapidly; by the end of their first, second, and third years in the pond they attain a total length of 4 to 4.5, 7.5 to 10, and 11 to 15.5 inches, respectively; the second- and third-year weights are 0.25 to 0.5 and 0.75 to 2.5 pounds, respectively. Growth rate of bass varied inversely with bluegill production, being fastest in least dense, bluegill populations. Rapid growth of bluegills was observed in ponds where the frequency of forage to predatory fishes had not exceeded a ratio of 12 to 1 among edible sizes of both species. Bluegills stocked as fingerlings grow to 7.5 inches (0.25 pound) during their third summer, provided that bass remain to prey upon young bluegills which are initially spawned in the summer after the season in which the pond is stocked. Partial removal of bass during the second year is accompanied by increased survival of bluegill offspring. In ponds where this had occurred, three-year-old bluegills, grown to an average size of 5.0 inches, had attained only ¼ to ⅓ the weight of three-year-old bluegills in other ponds containing adequate numbers of bass. Because of the characteristic instability of small fish populations, high yields of edible-sized fish cannot be expected without close management. Work is in progress to devise effective cropping techniques for sustained yields of edible-sized fish.

— *Karol J. Kucinski and Thomas Andrews in cooperation with the Department of Zoology.*

Potato Variety Trials. Seventeen varieties of potatoes were tested for comparative yields, habit of growth, and resistance to diseases, when grown under same soil and climatic conditions. The four highest yielding varieties were Chippewa, Pungo, Green Mountain, and Irish Cobblers, ranging from 462 to 429 bushels per acre, respectively. The four lowest yielding varieties were B515-2, B335-44, Cherokee, and

B73-10, ranging from 306 to 240 bushels per acre. The five varieties with the highest percent of starch, which is a measure of quality, were Green Mountain, B446-8, B355-44, Mohawk, and Irish Cobbler. For comparing results of similar tests at other stations, data are published by the "Plant Industry Station" in their annual report of the "National Potato Breeding Program."

— *Karol J. Kucinski.*

DEPARTMENT OF ANIMAL HUSBANDRY

VICTOR A. RICE IN CHARGE

A Study of the Mineral Elements of Cows' Milk. The work with arsenic is still in progress. A method that will destroy the organic matter of milk without volatilizing part or all the traces of arsenic present has not yet been found. It may be objected that it is not known whether arsenic is naturally present in milk or not: therefore, how can any be volatilized? However, in any process thus far tried, when known amounts of arsenic are added to milk before oxidation of the organic matter, 80 to 100 percent of the arsenic is lost.

—*J. G. Archibald.*

A Study of Quality in Roughage. The work on silage preservatives has been continued. Sulfur dioxide gas as a preservative has been given a second trial. Results are similar to those obtained last year. Silage treated with sulfur dioxide had a relatively low pH (3.7), high levels of carotene, considerable residual sugar, and better than average amounts of lactic acid. On the other hand, contrary to the usual situation with such a low pH, levels of butyric acid were rather high, and acetic acid content was very low or lacking entirely. The net result was a silage that had a peculiar odor and was not nearly so palatable to cows as silages to which hominy meal or citrus meal had been added.

Citrus meal gave results similar to those secured last year, with reasonably good odor and good palatability but not quite equal to hominy meal in these respects. Much lower losses of dry matter were noted this year than last for both sulfur dioxide and citrus meal (4.8 and 11.9 percent, respectively).

Final results for the year with our airtight, glass-lined steel silo are not yet available as the silo is only about half empty. Quality of the silage fed out to date from this structure, although reasonably good, is not superior to that of many lots of silage that have been obtained from conventional upright silos.

Considerable routine analytical work has been done on samples of silage sent in by farmers throughout the State. The object of this work has been to determine whether quality of silage from trench silos is comparable to that from upright silos. Determinations made have been: water, pH, protein, and carotene. Average figures for the fresh silages from trench and upright silos respectively were: water, 76.6 and 73.6 percent; pH, 4.8 and 4.7; protein, 3.3 and 3.8 percent; carotene, 19 and 23 milligrams per pound.

Except for pH, these differences, although small, are approximately what might be expected and are statistically significant at the 5 percent level. They are due probably to either inadequate drainage at the trench bottom or improper provision for shedding of surface water.

The differences are probably insufficient to offset the greater cost of storage in upright silos, unless they reflect large dry matter losses, an angle of the situation on which as yet we have little or no information.

In connection with these studies, which are aimed at giving the farmer the practical information he needs, some work of a more fundamental nature has been conducted. One result of this work has been a paper on "Sugar and acids in grass silage," which appeared in the April, 1953, issue of *The Journal of Dairy Science*. The most interesting conclusions from this report were the apparently quite different type of fermentation that took place in the silage when sulfur dioxide was the preservative and the marked difference in amounts of the several organic acids, especially lactic acid, in grass silages as compared with legume silages.

Another phase of this project carried on for the past two winter seasons is concerned with attempts to improve the feeding value for milk production of poor quality hay by the addition of certain supplements. Feeding this type of hay for milk production is not recommended as standard practice, but because of circumstances beyond their control, farmers frequently have a considerable tonnage of it to feed out. How best to dispose of it poses a problem, one possible answer to which is based on better nutrition of the rumen bacteria that ferment the cellulose of coarse feeds into short-chain organic acids, notably acetic and propionic acids. A search for supplements that will facilitate this process has been going on for some time at this Station and elsewhere.

Results of two years' trials with six Holstein cows indicate that (a) the cows gave 90 percent as much milk on a ration of poor hay and corn-and-cob meal supplemented with urea, molasses, and minerals as they did on a ration of good hay and a conventional grain mixture, and (b) urea alone as a supplement to the poor hay—corn-and-cob meal control ration caused very little increase in milk yield over the control.

—*J. G. Archibald, D. M. Kinsman, and J. W. Kuzmeski.*

DEPARTMENT OF BACTERIOLOGY

RALPH L. FRANCE IN CHARGE

Nitrification Studies with Dried Sewage Sludge. In a preliminary report (Mass. Expt. Sta. Bul. 467, p. 21, 1953) it was stated that the object of this investigation was to determine the effect of dried sewage sludge on the nitrification process in soil. Experiments were designed to study the effect of sludge on nitrification of the organic matter in soil as taken from the field, and nitrification of ammonium sulfate, cottonseed meal, and dried blood added separately to soil. The sludge contained no industrial wastes. Results to date indicate that the dried sludge did not interfere with nitrification of the substances investigated. On the contrary, slightly more nitrate was recovered from samples containing sludge than from samples without it. Two speculative explanations may be offered: some of the residual nitrogen in the sludge (about two percent) may have been nitrified; or some component, or components, of the sludge may have stimulated somewhat the nitrification of the substances investigated. Investigations here and elsewhere have indicated that well-digested and dried sludge as a source of humus in soil should present no menace to health. Consequently this type of dried sludge should have value for use as a conditioner of soils in need of humus.

—*James E. Fuller and George W. Jourdian.*

Activities of Soil Microorganisms with Relation to the Availability of Phosphorus in the Soil. One problem of great importance to agriculture in certain sections of the country is that phosphorus in soil combines with certain minerals to form compounds that are insoluble in water, with the result that neither the phosphorus nor the mineral is available for plant growth in the soil. It has been demonstrated by other investigators that salts of certain organic acids have chelating properties, i.e., they will combine with the mineral portion of a mineral-phosphorus compound and so release the phosphorus for plant use. The chelate-mineral combination subsequently will release the mineral as it is needed for plant growth. Iron availability is of particular importance in agriculture. The purpose of the investigation here reported is to study acid production by soil bacteria with the ultimate objective of attempting to induce production of organic-salt chelates. Work to date has included the isolation and purification of cultures of soil bacteria and the study of cultural conditions best suited to induce production of organic acids by these bacteria. Techniques have been adapted for identification by paper chromatography of the acids produced.

—*James E. Fuller and George W. Jourdian.*

Decomposition of Wood Wastes by Cellulose-Decomposing Organisms. Cultures of microorganisms that might be used to decompose wood wastes and yield marketable organic products were isolated and developed. Since cellulose is a principal constituent of wood, cellulose-decomposing organisms were sought for. Cultures were isolated from a number of sources and studied for their ability to decompose cellulose. With one exception, the cultures studied decomposed cellulose too slowly to offer much promise for their suc-

cessful use. The exception was an anaerobic organism that grew and functioned best at 55° C. At first, it was associated with another organism and appeared not to function without it. On repeated cultivation under selective conditions, the anaerobic culture alone was induced to decompose cellulose rapidly and effectively. On the basis of the information obtained, it appears that this culture could be employed effectively only under well-controlled conditions in an industrial plant because constant care, by trained technicians, would have to be exercised to maintain the culture in a satisfactorily active state.

—James E. Fuller and Wm. C. Squires.

Attempts to Improve the Efficiency of Farm and Commercial Vinegar-Making Methods. Determination of Optimum Conditions for the Conversion of Alcohol to Acetic Acid by Acetobacter. Growth factors of the acetic acid bacteria have been studied to devise a chemically defined medium that will support the growth of these organisms for the conversion of ethyl alcohol to acetic acid.

Vitamin requirements. It was determined that para-amino benzoic acid was needed for the growth of *Acetobacter xylinum*. Biotin stimulated the growth of *A. pasteurianum*, but was not actually required for growth. *A. aceti* and *A. ascendans* did not require any of the B vitamins for maximum growth; however, folic acid had a slight stimulatory action on the growth of *A. ascendans*.

Vitamin synthesis of *Acetobacter xylinum* It was determined that this organism synthesizes enough pantothenic acid, biotin, niacin, pyridoxine, and riboflavin to be easily detected after 48 hours of growth in a synthetic medium. This suggests a definite purpose for "mother of vinegar" in the vinegar generator, that of supplementing the vitamins required for the growth of the more rapid acetic acid–producing bacteria.

Amino acid requirements. The amino acid requirements have been determined for *A. xylinum* and *A. pasteurianum*. Isoleucine, valine and alanine were essential for *A. xylinum*, and proline, cystiene, valine, and glutamic acid are apparently essential for the growth of *A. pasteurianum*.

Vitamin content of cider and distilled vinegar. Because of the lack of knowledge of the vitamin content of vinegar, assays for the B vitamin were made. Results of these studies are not complete at this time.

—Warren Litsky, B. S. Tepper, and C. L. Goldman in cooperation with W. B. Esselen, Department of Food Technology.

Bacteriological Study of Sewage Disposal Plants. The conventional test for pollution by sewage, employing the coliform bacteria, may condemn the water of a river or stream used for irrigation purposes on the basis of soil contamination or a very old fecal contamination. On the other hand, the presence of enterococci, which originate only in the intestine and are more closely related to the enteric pathogenic bacteria, indicates recent fecal pollution only.

To test the validity of employing enterococci as test organisms for sewage pollution in rivers and streams used for irrigation purposes, the relative numbers of these organisms in sewage had to be demonstrated. Because of the poor results obtained when older detection methods were employed, the use of enterococci as indicators of recent fecal pollution has been discouraged. Employing the method of Litsky, Mallmann, and Fifield for the detection of enterococci, a positive correlation of + 0.9 exists between the numbers of coliform bacteria and enterococci in sewage from settling tanks of the Amherst Sewage Treatment plant during the entire year. Based upon the median value of all samples collected in this study, the density of coliform bacteria was only approximately 13 times that of enterococci. In another set of experiments, the ratio of *Escherichia coli* to enterococci was found to be approximately 1.8 to 1. This represents a recovery of nearly fifty times as many enterococci as had been previously reported.

—Warren Litsky and M. J. Rosenbaum.

The Effect of High-Temperature Pasteurization upon Pathogenic and Heat-Resistant Bacteria and upon Certain Properties of Milk.[1] Conventional short-time, high temperature milk pasteurization (at 161° F. for 15 seconds) has many advantages over the holder system (143° F. for 30 minutes), particularly for larger milk plants. However, one disadvantage of the high-temperature, short-time method is the difficulty in measuring and establishing the holding-time precisely. A solution to this difficulty is the elimination of the holding-time by increasing the temperature to the point where only the "come-up" time (time required to heat the milk to a given temperature) will insure adequate pasteurization. Laboratory scale equipment has been devised to heat the milk while in continuous flow, using electrical resistance heating in a small diameter (0.065 inch I.D.) stainless steel tube. High amperage, low voltage, alternating current is utilized over lengths of tubing varying from 2 to 10 feet. Extremely rapid "come-up" times are possible, giving as high as 1700° F. per second temperature rise. Preliminary observations on flavor, phosphatase destruction, and *Escherichia coli* destruction indicated that satisfactory performance was obtained at approximately 185° F. with "come-up" times of as little as 0.1 second. Future studies will include both heat-resistant and pathogenic bacteria.

—Warren Litsky, and R. B. Read in cooperation with D. J. Hankinson, Department of Dairy Industry.

A Comparison of the Effects of Terramycin Hydrochloride and Amphoteric Terramycin on the Fecal Flora of Humans. Antibiotic prophylaxis prior to intestinal surgery has been advocated by a number of clinicians and investigators. The consensus of this group is that the action of broad spectrum antibiotics and chemotherapeutic agents serves to "sterilize" the large intestine and thus decreases the possibility of general peritonitis after radical surgery. One of the antibiotics for this purpose is Terramycin (brand of oxytetracycline). To date, all the investigations of the action of this agent on the fecal

[1]This investigation is supported by a research grant, G-3853, from the National Institute of Health, U. S. Public Health Service.

flora have been performed with the hydrochloride form. Recently, an amphoteric Terramycin base has been released for distribution. It was hoped that Terramycin in this form, when taken orally, would cause less gastric disturbances than hydrochloride. An investigation comparing the two forms of the antibiotic was carried out, and the results are summarized below:

Twenty patients were put on a regime of 3 gm. of Terramycin[1] daily, administered 750 mg. orally every six hours. Seven of these patients received the hydrochloride form; thirteen received the amphoteric. Stools were examined daily.

The coliform bacteria disappeared after 72 hours of treatment with both forms of the antibiotic.

Patients receiving amphoteric Terramycin exhibited a lower number of enterococci and total aerobes per gram of feces than those patients receiving the hydrochloride.

Gastric disturbances were less frequent with the amphoteric form of Terramycin.

A difference in the mode of action of these two forms of antibiotic is suggested.

—*Warren Litsky, and S. A. Broitman in cooperation with J. R. Cohen, Pathology Laboratory, Springfield Hospital.*

The Effect of Hyamine 1622 on Certain Bacteria. Para di-isobutyl phenoxy ethoxy dimethyl benzyl ammonium chloride (Hyamine 1622) is often used as a sanitizing agent for barber implements. It was the purpose of this study to determine how effective this agent is against common bacteria under conditions of the laboratory and the barber shop. It was found that barber implements, sanitized by immersion in a 1:800 concentration of this quaternary ammonium compound for 10 minutes, showed a 98 percent reduction of bacteria. Laboratory test, using the "Use-Dilution-Rod" method, with *Micrococcus pyogenes var. aureus*, *Escherichia coli*, and *Bacillus megatherium* showed 100-percent kill after 10 minutes with the same strength of sanitizer. These and other results appear to indicate that quaternary ammonium compounds are satisfactory in the bacterial sanitization of barber implements.

—*Walter Ginsburg and Warren Litsky.*

---

[1]Terramycin was supplied through the courtesy of Chas. Pfizer & Co., Inc.

DEPARTMENT OF BOTANY

THEODORE T. KOZLOWSKI IN CHARGE

Improved Methods for the Control of Clubroot and Other Soil-borne Diseases of Plants. Investigational work on the use of soil-conditioners, the hydrolized polyacrylonitriles, Krilium, and Aerotil as possible soil fungicides or as carriers of soil fungicides was undertaken, for it has been said that Krilium had some effect in controlling the damping-off of seedlings. But in work done here, Krilium and Aerotil showed no soil fungicidal properties, failing to control either clubroot of cabbage or damping-off of seedlings of beet, cabbage, cucumber, lettuce, and tomato.

It was found that Krilium or Aerotil, and similar commercial fertilizers, may, however, be used as carriers of soil-fungicides. Thus, damping-off of the seedlings of these and other vegetables was concontrolled, and without chemical injury, by N-trichloromethylthio tetrahydrophthalimide (Orthocide 406) or technical dibromobutene (Shell OS1199) applied to soil, before seeding, in Aerotil or Krilium used as a carrier.

Tannic acid applied to soil before seeding did not affect the growth of other species of ornamental plants but did improve the early growth of foxglove, *Digitalis purpurea* L.

Formaldehyde in water applied to soil immediately after seeding controlled damping-off without chemical injury to most vegetables but retarded the germination of seeds and the early growth of seedlings of the scarlet sage, *Salvia splendens* Sallo.

Some attention was given to the effects of liming on the efficacy of soil fungicides, and it was found that Orthocide 406, Shell OS1199, and Vancide (which is a salt of dimethyl dithiocarbamic acid and 2-mercaptobenzothiozole) were more effective in controlling damping-off of seedlings in limed soils than they were in soils without lime.

Orthocide applied in fertilizer to soil prior to seeding failed to prevent clubroot of broccoli.

When treatments were first applied to soil after the emergence of seedlings of lettuce, cucumber, beet, tomato, and cabbage, better and safer control of damping-off was given by 2,3-dichloro-1,4-naphthoquinone (Phygon). Thus used, there was more chemical injury or less complete control of damping-off by the other fungicides named above.

—*W. L. Doran.*

Damping-off and Growth of Seedlings and Cuttings of Woody Plants as Affected by Soil Treatments and Modifications of Environment. Work on the effects of fungicides and root-inducing substances (used separately or together) on the rooting of cuttings was continued. These substances were applied to cuttings both as solution-immersion and powder-dip treatments. Rooting of cuttings of several species was improved by treatment with 2,3-dichloro-1,4-naphthoquinone (Phygon) in a carrier of talc, both with and without indolebutyric acid, a root-inducing substance. Similarly used, in combination with talc, or with indolebutyric acid in talc, N-trichloromethylthio tetrahydrophthalamide (Orthocide 406) increased the percentage of rooting of cuttings of white pine and species of Taxus, Chamaecyparis, and Juniperus.

At the request of the Department of Forestry, some work was done on the vegetative propagation of Ginkgo. It was found that stem cuttings of this tree root well even without treatment with a root-inducing substance, if cuttings are made of the apical parts of new shoots and taken in mid-June. A paper on the subject has been accepted for publication in the *Journal of Forestry*.

At the request of the Cape Cod Beach Plum Growers Association, investigation of the vegetative propagation of beach plum was resumed. Root-cuttings of beach plum lived and grew in the largest percentages when such cuttings were made from the upper parts of roots taken from young plants in late winter or spring and set vertically in the rooting medium, sand, with the proximal end exposed to the light and air. Root-cuttings taken from old plants gave poor results.

In cooperation with the Department of Forestry, stem cuttings from ten superior individual white pine trees were rooted. Such cuttings rooted better, in larger percentages, if taken in late winter rather than in fall or early winter. Effects of treatments on subsequent growth and survival are under observation. White pine trees grown from cuttings rooted in earlier years are now increasing in height at the rate of 14 to 18 inches a year.

—*W. L. Doran.*

Effects of Soil Moisture Stress on Carbohydrate Development in Plants. Effects of soil water deficit on growth and carbohydrate content of tomato (*Lycopersicon esculentum* Mill.) and bean (*Phaseolus vulgaris* L.) were studied. Representative plants were harvested and analyzed for carbohydrate content at three periods: (1) just before the soil reached permanent wilting for the first time; (2) after plants had remained in soil at wilting percentage for 24 hours, and were reirrigated and remained at moisture equivalent for 24 hours; (3) at the end of two weeks of growth, during which time plants were subjected to four periods of moisture stress, and reirrigated to moisture equivalent after the first three droughts, then samples were taken at the end of the fourth drought, which was not followed by irrigation.

Carbohydrate analyses consisted of quantitative determinations of reducing sugars, nonreducing sugars, and starch.

Before plants had reached the permanent wilting percentage for the first time both forms of sugars decreased, and starch decreased. Following irrigation, there was a rapid and marked increase of starch, and decrease in sugar content. At the end of eight weeks' growth, total carbohydrates per gram sample of test material were much less than at any other period of growth.

It was concluded that water is not equally available to plants in the range between field capacity and wilting percentage. Plants that have been grown in soil that is allowed to dry almost to the wilting percentage for the first time suffer setbacks in their ability to manufacture carbohydrates. Irrigating such plants to field capacity wil effect some increase in photosynthetic activity and resultant increased supplies of reducing sugars, sucrose, and starch. Subjecting test plants to continued drought followed by irrigation resulted in much reduced capacity to store reducing sugars, sucrose, and starch. The

greatest differences between carbohydrate contents of control and test plants were manifested when plants were subjected to several severe droughts.

—T. T. Kozlowski and D. H. Woodhams.

Investigation of Fungicides that Promise Value in Apple Disease Control. The results for the year 1952 are enumerated as follows: Almost all unsprayed McIntosh apples were scabby; 54 percent of them showed primary scab. All treatments gave excellent scab control. Fruit scald from combined sulfur and weather was important on Baldwin and McIntosh regardless of particle size and amount of sulfur in 100 gallons of water. Severe injury resulted from application on June 24. About 2.5 percent of the McIntosh apples sprayed with Thiram and insecticide showed black calyx cups or arsenical injury. About 28 percent of Red Delicious apples from a Phygon-Sulfur paste schedule were russetted; 9 percent from Kolofog-Thiram. The amount of actual sulfur in 100 gallons of water was 2.8 pounds in Phygon-Sulfur, 1 pound in Kolofog-Thiram.

Phygon foliage chlorosis was serious, especially on Baldwin and McIntosh. Crag Fungicide 341 in a through schedule of applications gave evident control of mite, but the finish, especially on Baldwin, was dull and like sandpaper. Fruit finish with Orthorcide 406 was excellent, but on Delicious it caused a leaf spotting.

Studies for the 1953 season at Waltham are as follows: Fungicide added to Superior Oil at the delayed dormant period is desirable for early protection against apple scab. Tests show that the fungicide may be Phygon ½ pound, Bordeaux 2-4-100, Ferbam 1½ pounds, or a neutral copper fungicide. Orthocide and copper fungicides are compatible generally with both types of Superior Oil. No fruit russetting was observed from using copper fungicides with oil at delayed dormant.

Orthocide again caused an objectionable injury to Delicious foliage. Following an application of 2 pounds of Orthocide to 100 gallons of water to McIntosh trees with scabby foliage on June 8, no germinating scab spores were recovered on June 9 and 12. On June 16, 23 percent of the scab spots showed some spore germination, but it was weak.

In laboratory tests, phenyl mercuri acetate gave a borderline toxic action on scab at dilutions of 1/7 to 1/4 pint to 100 gallons of water, and 3/8 pint was as toxic to scab spores as 1/2 pint. Phenyl mercuri lactate showed a borderline toxic action to scab at 1/4 pint and stronger dilutions from 1/2 to 1 pint were equally toxic. Phenyl mercuri ethylene-diamine gave a borderline toxic effect at 1/12 pound and higher dilutions of 1/6 pound to 1/2 pound were equally toxic.

Two successive sprays of phenyl mercuri lactate 1/2 and 1 pint with lead arsenate were applied to apple trees on May 7 and 15 (Calyx May 13). Scab eradication was shown in 93 percent of the spots from 1 pint, and 74 percent from 1/2 pint. There was some yellowing of early spur leaves in both cases.

Rhode Island Greenings with a snowball bloom were sprayed in mid-bloom (May 12) with phenyl mercuri acetate (Tag) 0.83 pint. Foliage injury was severe. The leaf blades severed at the base leaving the new growth with numerous bare petioles. The set of fruit was 37 apples to 100 spurs in contrast to 98 from no spray in bloom. The

concentration of the phenyl mercuri sprays is a factor in numerous cases of injury, loss of leaves, and fruit set in commercial practice.

The toxicity of phenyl mercuri ethylene-diamine 3/8 pound, lactate 3/4 pint, and acetate 3/8 pint to scab spores was not impaired by adding lead arsenate, methoxychlor or wettable 50 percent DDT.

Rows of trees comprising different varieties were sprayed in June with four types of phenyl mercury on a comparable chemical dilution to determine whether differences in tolerance could be shown biologically. The schedule of treatments in June and the degree of foliage injury indicated by the number of asterisks is as follows:

EVALUATION OF PHENYL MERCURY FUNGICIDES

Waltham Field Station, 1953

Treatment	Date of Application			Leaf Yellowing and Defoliation, July 5-10		
				Red Del.	R.I. Green	McIntosh
Tag, 3/8 p.	June 8	June 16	June 29	****	***	*
P. Agr. Spr., 3/4 p.	"	"	"	*	*	
P. Apple Spr., 3/8 p.	"	"	"	***	*	
Coromerc, 3/8 lb.	"	"	"	*	*	
Insecticide only	"	"	"			
Orthocide, 2 lb.	(*) "	P. Agr. Spr. 3/4 p., Orthocide 1 lb.	"	***	****	**

*Combined Ferbam 3/4 lb. and Phygon 1/4 lb. applied April 24, May 4, 18 and 26.

June 8, combined with Marlate 3 lb.; June 16, combined with Marlate 2 lb. and Lead Arsenate 2 lb.; June 29, combined with Lead Arsenate 2 lb., Nicotine Sulfate, 3/4 pint. Subsequent sprays, Lead Arsenate 2 lb., Wettable DDT (50%) 2 lb.

Taxonomy, Infection Cycle, and Fungicidal Control of Peach Canker Caused by the Fungus *Fusicoccum amygdali* Delacr.

Fusicoccum fungus causing the peach canker disease is *F. amygdali* Delacr. originally described in France as the cause of the spot disease of almond twigs (*Amygdalus communis*). Pycnidia of the fungus seated in the cankers erupt spores as the new growth begins in the spring and continue throughout the growing season. Fungus infects new bud growth on wood of the previous season and the axils of leaves of the current season's growth.

Fusicoccum cankers and the blighted distal twig growth beyond the cankers become invaded by other pathogens, notably by Cytospora [*Valsa lencostoma* (Pers.) Fr.] to add to the destruction of the branches. Fusicoccum cankers were readily produced artificially by inoculations of Cumberland and Golden Jubilee with pycnospores in water.

Wettable sulfur used for brown rot control is not toxic to Fusicoccum pycnospores which would explain the upbuild of canker in southeastern Massachusetts peach orchards. Toxicity was shown by ferbam, Phygon, Thiram, and Captan. A fungicidal schedule providing continuous protection beginning with an early spring dormant application (lime sulfur plus ferbam or Phygon) for leaf curl is important. Thorough seasonal protection of new growth with fungicide supple-

mented by pruning in the dormant season and in the early half of the growing season has given satisfactory control of canker in orchards under investigation in Bristol County.

—*E. F. Guba, Waltham.*

Root Diseases of Parsnips and Control Measures. Work has involved artificial culturing and identification of pathogens involved in parsnip root diseases, examination of parsnip fields, study of diseased fall and spring dung and winter-stored parsnips from inside storages and outside pits. Important pathogens recovered are *Sclerotinia sclerotiorum* (watery soft rot), *Rhizoctonia solani* (dry rot), *Erwinia carotovora* (bacterial soft rot), *Rhizopus nigricans* (black mold rot), *Penicillium expansum* (blue mold rot), *Botrytis cinerea* (gray mold rot) and *Itersonilia perplexans* (black root blotch). The last disease is an important factor predisposing root crowns to invasion by all other pathogens causing a decay called "sore head." Applied control studies will concentrate on the Itersonilia and Sclerotinia diseases.

The following methods of control are suggested: (1) protectant spraying with fungicides; (2) ridging soil over crowns to provide mechanical barrier to fungus; (3) cautious artificial irrigation; and (4) planting on well-drained land.

The pathogens *Cercospora pastinacae* (Sacc.) Peck and *C. pastinacina* Solh. were observed to be important causes of foliage blighting.

—*E. F. Guba, Waltham.*

Breeding Forcing Tomatoes for Resistance and Immunity to Cladosporium Leaf Mold. Tomato Hybrids 2-22 and 23 described in a previous report and immune to the leaf mold disease have been grown for further selection and comparison. Hybrid 2-22 is the most desirable commercial type on the basis of grower trials and has been named Waltham Mold-Proof Forcing. Immune Hybrids 2-22 [Improved Bay State X (Impr. Bay State X Peruvianum Hybr. 44 B292)] have been outcrossed to the Waltham Forcing tomato in an effort to produce an even better red forcing tomato for the greenhouse tomato industry. The second generation of these hybrids (spring crop 1953) are segregating in a ratio of 1 susceptible to 3 immune to the pathogens. Immune lines will continue to be grown for selection for immunity and best commercial type until stabilized.

—*E. F. Guba, Waltham.*

Systematology, Ecology, and History of the Monochaetiae and Pestalotiae. This is a monographic study of a large group of fungi of world-wide distribution and of considerable economic importance. Three sections of the study are completed; three more remain. Mycologists in the Bureau of Plant Industry, U.S.D.A., have offered to collaborate in a critical study of the manuscript.

—*E. F. Guba, Waltham.*

Study of Bacteria in Frenching and Nonfrenching Soils. There is considerable evidence supporting the theory that a microflora is in some way related to frenching of tobacco. If a frenching soil is auto-

claved, air-dried, or treated with a fumigating gas (methyl bromide), the soil loses its power to produce frenching. A study was made of soil samples taken from frenching and nonfrenching soils and at a soil temperature which produced frenching (35° C.) and at a soil temperature which did not produce frenching (21° C.) The results did not show any significant differences in the two soils at either temperature. All the bacteria isolated were gram-positive sporulating rods. A quantitative survey was made of the anaerobic bacteria in both the frenching and nonfrenching soil with results indicating the presence of three and one-half times as many anaerobic bacteria in the nonfrenching soil.

—L. H. Jones and S. H. G. Allen, Jr. in cooperation with the Departments of Botany and Bacteriology.

Frenching of Tobacco. This unique physiological disease originates in the soil but evidently produces no symptoms unless relatively high temperatures and high moisture content prevail. Two new sources of frenching soil were tested. Probably tobacco has never been grown on either of them. One of these was on the light sandy side; the other, a heavy black loam. Both of these soils were from low, poorly drained terrains and were moist even in drought periods.

Frenching not only affects the shape of the leaf but it also almost completely stops terminal growth. Subsequently, axillary growth develops the whole length of the stalk. This axillary growth can be stimulated by topping the frenched plant. The application of maleic hydrazide in paste form applied to the topped surface has taken the place of the inhibitroy hormone that normally is produced in the terminal shoot and prevents axillary development.

The soil conditioners, Krilium and Aerotil, when used in relatively large concentration were effective in preventing frenching. The action of the Aerotil was probably due to the alkaline condition of the soil, because the Aerotil changed the reaction of the soil from a pH value of 5.00 to 7.60. Two forms of Krilium were used; one lowering the reaction from a pH value of 5.55 to 5.20; and the other raising the reaction from 5.55 to 6.70.

A disease of cotton plants called "crazy top" occurs under conditions similar to those that induce frenching of tobacco. Growing cotton experimentally in two separate frenching soils failed to produce "crazy top," although the tobacco plants in the same soils were severely frenched. Thus it is evident that "crazy top" is not in the frenching category.

It is possible that the frenching of tobacco is not caused by a single factor. Preliminary grafting experiments of a reciprocal nature indicate that when potato, tomato, and Jimson weed are grafted into tobacco as a stock, the stock can be made to produce frenched axillary growth, but the cions show no indication of frenching. On the other hand, when potato and tomato are used as stocks and tobacco as the cion, the potato stock does not contribute symptoms of frenching to the tobacco, but the tomato stock does. Future work is necessary to confirm this phenomenon with an idea that a satisfactory answer can be found to give more information on the nature of the frenching factor.

—L. H. Jones.

Chemical Soil Treatment for the Control of Fusarium Wilt Caused by Fusarium Oxysporum F. Dianthi. Fusarium wilt is one of the major diseases of carnations. Wilt resistant varieties of desirable commercial type are not available, and since the disease is soil-borne and carried in propagation stock, chemical control methods are being tested. The following chemicals, Dithane Z-78, XP-47 (dibromobutene) Goodrite ZAC, Crag F-531, Natriphene, and chlorobromopropene were employed.

Crag F-531, Natriphene, and Dithane Z-78 were rated first, second, and third most effective treatments for the control of wilt on the Hercules Virginia variety, whereas Crag F-531, Dithane Z-78, and Goodrite ZAC were most effective treatments on the Northland variety.

None of the treatments equalled the steam-treated checks in the production of flowers. Dithane Z-78 and Natriphene plots yielded the highest number of Hercules Virginia flowers. Crag F-531 and Natriphene plots yielded the highest number of flowers in the Northland variety. The bromine compounds gave the lowest yields.

Initial and final pH of the soil in treated plots was found to differ very slightly.

In routine soil samples the test materials did not affect the essential elements tested, i.e., N_2, P, K, Ca, Mg, NH_4NO_3, and Al.

The soluble salt tests showed that final readings were higher than initial readings in the Dithane Z-78 and Crag F-531 treatments. Final soluble salts readings were lower than initial readings in the Goodrite ZAC, Natriphene, and chlorobromopropene tests.

—*E. C. Gasiorkiewicz, Waltham.*

Determination of Fungus and Bacterial Pathogens in Commercial Propagating Stock in Carnations. Culturing of carnations to determine disease incidence of fungus and bacterial pathogens is proving to be the most reliable method of screening plant material. Carnation material consisting of the leading Sim varieties and Millers Yellow from five sources was indexed, and percentages from 50 to 1.6 percent were obtained. The method has proven itself to be a diagnostic tool to detect infection in carrier hosts that are symptomless under normal growing conditions. The perpetuation of this cultured material in mother blocks has been attempted commercially, and observations on these plots indicate that precautions of isolation, proper sanitary cultivation and protective spraying are necessary to maintain the health of these plants.

—*E. C. Gasiorkiewicz, Waltham.*

Effect of Carnation Mosaic, Carnation Streak, and Carnation Yellow Virus on the Production of Carnation Flowers. The effect of carnation mosaic virus on production of carnation flowers is being studied. Distinct clonal lines of Yoder #115 seedling were increased and maintained in lots as carnation-mosaic-free and carnation-mosaic-infected. The experiment has not progressed to the stage of flower production. No results are available.

—*E. C. Gasiorkiewicz, Waltham.*

Properties of Carnation Mosaic Virus. Carnation mosaic virus is the most common virus found in commercially grown carnations. In continued studies regarding the properties and characteristics of the virus, it was found that temperature had an effect on symptom expression in the carnation (*Dianthus caryophyllus* L.) and Sweet William (*Dianthus barbatus* L.) Controlled temperature studies at 16°, 20°, and 24° Centigrade showed that symptom expression on the host plant as well as the indicator plant was quicker with an increase in temperature. Virus-free carnation seedlings of Eleanor x John Briry parentage were used in the trials. The symptoms were identical to those manifested at normal greenhouse temperatures. The effect of high temperature in faster symptom expression will expedite biological assay testing for virus presence in carnation material.

—*E. C. Gasiorkiewicz, Waltham.*

Properties and Importance of Some Fungus and Virus Diseases of Carnations and Their Control Measures. Culturing of carnations for determining fungus and bacterial pathogens in commercial propagating stock was continued on 5,000 samples. The method is critical to the extent that 1.6 percent infection from a 1,000 plant lot from an apparently healthy source was clearly detected. The percentages of infection varied from 50 to 1.6 percent on similar varieties dependent on source of material.

The following fungicides are being used for chemical control of Fusarium wilt: Dithane Z-78, Crag F-531, Crag 957, Vancide 51 ZW, Mathieson 275, Crag 1182 F, and Fulex. Orthocide 406, Vancide 51 ZW, Manzate, Dithane Z-78, and Parzate are being used for rust control. Mathieson 275 is being tried for Rhizoctonia control. To date no data are available on these treatments.

Host range studies with 23 additional species of plants from widely unrelated groups have not revealed any new local lesion hosts.

Preliminary diagnostic tests using ultra violet absorption were conducted and are being continued.

—*E. C. Gasiorkiewicz, Waltham.*

DEPARTMENT OF CHEMISTRY

WALTER S RITCHIE IN CHARGE

The Production of Holocellulose From Nonwoody Plant Tissue. The production of holocellulose and the subsequent determination of cellulose should permit an estimation of hemicelluloses from the original extracts. Extractions of the cellulose should also make possible a logical fractionation of the hemicelluloses. Such a procedure is not now available but would find a place in the scheme of analysis for plant material. Details of the operation are being worked out.

Cellulose obtained from cranberry pulp by this method was shown to be abnormal in several respects. It is usually light brown in color instead of white because of its sensitivity to alkaline solutions; approximately 60 percent of the product is called lignin because it is resistant to the action of 72 percent sulfuric acid. Normally a cellulose obtained under these conditions contains from 1 to 4 percent of lignin. Further investigations are being conducted on the nature of this cellulose.

Preliminary data indicate that the quality of certain roughages may be estimated by a modification of a turbidity test previously developed in this laboratory.

—*Emmett Bennett.*

Nature of Winter Hardiness in the Raspberry.

—*J. S. Bailey, F. W. Southwick, and Emmett Bennett in cooperation with the Departments of Pomology and Chemistry.* (See Department of Pomology.)

The Spectrophotometric characterization and Estimation of the Constituents of Certain Naturally Occurring Substances with Special Reference to the Carbohydrates of the Plant Cell Wall. Primarily, our objective is to be able to indicate qualitatively within certain limits the composition of natural products, particularly of a carbohydrate nature, which may be made to respond under the general conditions of the method. The procedure has been applied to many pure and impure natural products. Graphic representation of the data obtained seems highly specific. However, certain groups in related compounds appear to be so dominant that the presence of one substance may not even be indicated although present in relatively high concentrations. Thus, although not highly selective at this point, the over-all information in characterizing natural products is of value and should become more so, as interpretative technique is improved. Investigations of a quantitative nature have not been attempted.

—*Emmett Bennett.*

Influence of Processing, Distribution, and Storage on the Loss of Ascorbic Acid in Milk.

1. *Ascorbic acid in tocopherol-enriched milk.* Investigators have found widely variable amounts of tocopherol (vitamin E) in cows milk apparently influenced by the amount of tocopherol in the forage consumed by the cows producing the milk. It is also reported that there is a significant correlation between the tocopherol content of milk fat

and the ability of milk to resist the reaction, involving ascorbic acid oxidation, that produces oxidized flavors. These observations raised a question regarding the possibility of enhancing the stability of ascorbic acid by enriching commercial cows milk with tocopherol. Milk was pasteurized, cooled to 40°F., divided into 500-ml. portions, and placed in quart, flint glass commercial milk bottles. One bottle was retained as a control, and alpha-tocopherol was added to seven bottles at the rate of 0.2, 0.4, 0.8, 1.2, 1.6, 2.0, and 2.4 mg. per liter. Such a series of eight samples was prepared on 16 Mondays during the academic year, and the samples were stored in darkness at 50°F. for 96 hours. The samples were assayed for ascorbic acid as soon as they were prepared and at subsequent 24-hour periods. The 16 control samples averaged to lose 72.5 percent of their reduced ascorbic acid during the 96 hours of storage, which is in agreement with losses observed in previous studies in this laboratory. The addition of alpha-tocopherol to milk, particularly the larger amounts, decreased somewhat the loss of reduced ascorbic acid from milk during storage but not enough to justify its use on a commercial scale.

2. *Value of Nitrogen for Stabilizing Reduced Ascorbic Acid in Milk.* Milk as drawn from the cow is a good source of reduced ascorbic acid, vitamin C, but during processing, storage, and distribution loses a significant portion of this essential nutrient. Accumulated data indicate that several factors, such as heat, light and air, destroy the reduced ascorbic acid in milk. Furthermore, experimental evidence reveals that reduced ascorbic acid in milk is destroyed by oxidation. Thus, any procedure for inhibiting oxidation should help to conserve the vitamin value of milk. A study was conducted to determine the value of adding nitrogen to milk to preserve its reduced ascorbic acid content until the milk reached the ultimate consumer. On 25 Monday mornings during the academic year, samples were collected of milk that had been pasteurized by the holding method for 30 minutes at 143°F. At the laboratory, the milk was thoroughly mixed, placed in 1000 cc. cylinders, and treated with nitrogen gas. One half liter of the treated milk and a like quantity of control milk were placed in commercial flint glass quart bottles and stored at 10°C. for 96 hours. Both the experimental and control milks were assayed for reduced ascorbic acid when they were placed in storage and at subsequent 24-hour periods. The nitrogen-treated milk retained its reduced ascorbic acid much better than the control milk during the first two days of storage; only about 20 percent was lost as compared with more than 60 percent for the control milk. The total loss during the 96-hour storage period was 70 percent and 73 percent for the nitrogen-treated and the control milks. Since a large amount of commercial milk is consumed within two days after it is processed, treating milk with nitrogen could conserve a large amount of reduced ascorbic acid which occurs naturally in this extensively used food.

—*Arthur D. Holmes.*

Increasing the Length of the Storage Life of Butternut Squashes.

1. *Storage Life of Mature and Immature Butternut Squashes.* The squash seed was planted May 25 and fertilized with a 5-10-10 fertilizer at the rate of 900 pounds per acre. During the 126-day growing season,

the climatic conditions were: 925 hours of bright sunshine, a temperature range of 36°F. to 90°F with an average of 66.8°F., relative humidity of 59 to 96 percent with an average of 78 percent, and a total rainfall of 17.44 inches. At harvest the squashes were cut from the vine and a stem 3 to 5 inches long was left to prevent an open wound on the stem end. Sixty mature and sixty immature (light cream colored, with longitudinal green stripes) were placed on shelves in darkness. During the 211-day experimental period, the temperature varied from 39° to 74°F. with an average of 60°F., and the average relative humidity was 76 percent. The spoilage loss was due principally to black rot *Mycosphaerella citrullina*. During the seven months of storage the mature squashes lost an average of 35.2 percent of their original weight, and the immature squashes lost 38.8 percent. In the first 150 days of storage the spoilage loss was larger for the immature than for the mature squashes, but during the remaining 61 days the trend was reversed, and at the end of storage 25 percent of the mature and 38 percent of the immature squashes remained. In general, the spoilage loss and the weight loss were as favorable for the immature as the mature squashes, and it was concluded that it was commercially feasible to place immature Butternut squashes in winter, shelf storage.

—*Arthur D. Holmes.*

Cation Exchange Capacity of Plant Root Colloids as Related to Cation Uptake. The mineral composition of plants, it appears, is largely determined by physical–chemical relations between the colloidal systems of both the plant root and the soil. Colloids of high cation exchange capacity adsorb divalent cations as Ca^{++} and Mg^{++} with much greater energy than the monovalent cation K^{+}. Conversely, low cation exchange colloids adsorb K^{+} with much greater energy than Ca^{++} and Mg^{++}. Cation exchange values for plant roots should aid in studying the fertility requirements of plants.

Cation exchange capacities of plants in addition to those listed in SOIL SCIENCE 1951,72:139 have been determined. These include larkspur (annual) 94.6 me/100 gms. dry roots, sweet pea 42.1, gladiolus 39.5, chrysanthemum 40.7, crimson clover 41.7, sweet clover 38.5, buckwheat 39.0, Manganese bur clover 21.5, rye grass 22.5, field brome 18.0, corn inbreds Ind. WF9 17.0 and Ohio 40B 13.5, millet 12.2, and Bermuda grass 10.5.

Interesting differences in the cation values of the roots of lupines were found: blue 53.3, yellow 47.7, and white 41.3. In Europe the blue lupines are grown on the more fertile soils high in available K: the white and yellow on sandy less fertile soils low in available K. Based on the principle of cation adsorption as related to cation exchange capacity, one would expect the white and yellow lupines with roots of lower exchange value to be more effective in obtaining K^{+} than the blue lupine.

The differences in cation exchange values of the two corn inbreds are also of interest. Ind. WF9 with the value of 17.0 should be less effective in K^{+} uptake at low soil K levels, but much more effective in Ca^{++} and Mg^{++} uptake than Ohio 40B. Inbred Ohio 40B and hybrids from this inbred parent are known for their observed magnesium deficiency symptoms.

The cation exchange value of plant roots may offer a valuable tool to the plant breeder in selecting plants with ability to utilize low levels of available K and for selecting plants that will be high in Ca^{++}, Mg^{++}, and Co^{++}.

—*Mack Drake, Dale H. Sieling, and Jonas Vengris.*

Yield and Vegetative and Chemical Composition of Forage Crops as Affected by Fertilizer Treatment. An important agronomic problem in the Northeastern Region is that of maintaining desirable production and stands of superior perennial legumes and grasses. Ladino clover and alfalfa are superior legumes. Late maturing leafy selections of orchard grass, smooth brome grass, and timothy are high yielding perennial grasses. Additional information on the fertility requirements and effects of management on these superior legumes and grasses is needed.

Ladino clover, alfalfa, late leafy orchard grass, smooth brome grass, and timothy were seeded separately in 1949 in field plots on a well drained Merrimac sandy loam (wind blown soil). The soil contained 40 pounds Truog phosphorus and 100 pounds exchangeable K_2O per acre. Three rates 50, 100, 200 pounds P_2O_5 per acre as 20 percent superphosphate were applied in bands 3 inches deep by 7 inches apart. All plots received 100 pounds K_2O per acre at planting time. Two treatments did not receive additional potassium, three received 100 pounds K_2O per acre after the first and second cuttings in 1950, and 50 pounds K_2O per acre after first and second cuttings in 1951 and 1952. Two treatments] received potassium in April after the first and second cuttings at the rate of 100 pounds K_2O per acre in 1950 and at the rate of 50 pounds K_2O per acre in 1951 and 1952.

Timothy was the highest yielding grass on low K plots in 1950 and 1951, but by 1952 had been replaced by red top, bent grass, and Kentucky blue grass. Increases of 78, 42, and 35 percent, respectively, were produced in three years by two 100 pound K_2O applications in 1950, and two 50 pound K_2O applications in 1951 and 1952 on orchard grass, smooth brome grass, and timothy.

Top dress applications of K were of great importance in maintaining stands of alfalfa, Ladino clover, timothy and smooth brome. Orchard grass plants persisted at low K levels, but yields were very low.

Although 400 to 650 pounds of K_2O per acre were applied in three years, there was almost complete removal (79 to 95 percent) of the applied K by the three grasses studied. This points up the fact that it is very difficult to increase the reserves of soil K when producing large yields of the forage grasses, timothy, smooth brome, and orchard grass. Under present systems of management these forage crops may seriously deplete soil K reserves.

Yield increases produced by rates of phosphorus were small. The efficiency of P removal in 3 years by the forage crops was important, equal to 183, 170, 138 and 113 percent of the 50 pounds applied P_2O_5 by orchard, brome, timothy, and ladino, respectively.

Since the soil on which this study was made, is of wind-blown or loessial origin, application of the results may be made over a wide area of Massachusetts. From this and additional studies it is recommended that 100 to 200 pounds P_2O_5 be applied at seeding time. After the first

cutting or pasturing, 300 to 400 pounds of an 0-15-30 should be applied. This should supply the P requirements for three years. After each of three cuttings or pasturings 60 to 90 pounds of K_2O should be applied to alfalfa and Ladino clover with orchard grass, smooth brome grass, or timothy to supply the K requirements, thereby increasing longevity of stand and insuring high production and quality of forage.

—Mack Drake, John L. Parsons, and William G. Colby in cooperation with the Departments of Agronomy and Chemistry.

THE CRANBERRY STATION
EAST WAREHAM, MASS.

C. E. CROSS IN CHARGE

The 1952 cranberry crop on the State Bog fell below 300 barrels, smaller than any other crop under State ownership. The severe drought and heat of June and July was largely responsible, but the heavy crop of 1951 seems also to have depleted prospects somewhat. The Massachusetts crop as a whole totaled 440,000 after a bloom and set of fruit that promised a crop larger than ever before raised in the State. The great heat of June 26 (reaching 138°F. on one bog) and the severe drought of July took an estimated 200,000 to 250,000 barrels. The keeping quality of the crop proved to be good, as had been forecast by the Cranberry Station.

Frost Forecasts. The frost warning service station, sponsored by the Cape Cod Cranberry Growers' Association with the cooperation of the U.S. Weather Bureau at Logan Airport, has been continued. There were 188 subscribers in the Fall of 1952, and 197 in the Spring of 1953. The most damaging frost last fall came on September 8 at the beginning of the harvest and took an estimated 1 percent of the crop, chiefly in Barnstable County. Damaging frosts occurred this spring on the nights of May 23 and 30, and June 2, taking an estimated 2, 2, and 1 percent of the crop, respectively. The frost warnings were issued during this year from radio stations WBZ, WOCB, and WBSM as a public service.

—C. E. Cross.

Weed Control in Cranberries. Efforts have been concentrated on the finding of a feasible killer of brambles (Rubus sps.). Numerous experiments with amine salts and esters of 2,4-D and 2,4,5-T in water and in oil have been tried mostly on bog shores, but sometimes among cranberry vines. To date, although we have often succeeded in killing all bramble stems and foliage, sprouts from the bramble roots soon regenerate the tops. All tests so far made have been more injurious to the cranberry vines than to brambles.

A large number of late-holdings of the winter flood have been inspected to determine their value in controlling the small bramble

(Rubus). Holdings to June 12, 1953, near the coast at Manomet, and at several places in Barnstable County failed to kill the bramble, but holdings to June 5, 10, and 12 at inland locations in Carver, Plympton, and Middleboro all showed 80 percent or more of the brambles to be dead.

Preliminary tests with chloro IPC applied at the rate of 2, 4, 6, and 8 pounds an acre in April failed to kill the perennial rice cutgrass or prevent the germination of the annual barnyard or corn grasses. Cranberry vines, though dormant when sprayed, failed to produce flowers after this treatment. All terminal buds were killed, but the cranberry vines did not appear injured otherwise. Though tested as a weedkiller, chloro IPC may have a special value in preventing the flowering of new plantings of cranberry vines, thus inducing more rapid vegetative growth.

Heavy applications of kerosene (2000 gallons an acre) applied during the last half of October showed good selective control of poison ivy and wild bean on about five acres treated commercially. To avoid cranberry vine injury in this work, it is essential that the vines should not be picked or otherwise disturbed during the proceeding harvest season.

Several bogs are in the process of being summer-flooded in 1953 for the purpose of killing various species of brambles. Results of this work will be reported next year.

—C. E. Cross.

Cranberry Disease Investigations. The two usual keeping-quality forecasts were made and sent out about April 1 and June 1, 1952, and both of them proved encouragingly accurate despite the abnormally dry summer.

Some further study was made of the keeping quality of berries picked by machine, with the result that berries from vines previously combed by machine showed little evidence of bruising and kept well. Those picked from vines not previously combed by machine, and those picked in heavy weed growth (especially cutgrass and brambles), were considerably damaged and suitable only for immediate canning.

—C. E. Cross.

Injurious and Beneficial Insects of the Cranberry.

Prevalence of Cranberry Insects in the Season of 1952

Root grubs	Normal
White grubs	Normal
Grape Anomala	Very little
Gypsy moths	Trace (2 caterpillars found in Plymouth County; none in Barnstable County)
False army worms	Light
Blossom worms	Normal
Weevils	Heavy (still increasing in Plymouth County)
Black-headed fireworms	Light to normal
Yellow-headed fireworms	Light

Blunt-nosed leafhoppers	Normally abundant
Spittle insects	Normal
Tipworms	Normal
Fruitworms	Heavy (millers plentiful in June)
Green spanworms	Normal
Brown spanworms	Very light
Spotted and Black cutworms and Army worms	Normal, some bogs heavily infested
Girdlers	Light
Brown grasshoppers	Normal
Cranberry scale	About normal, quite a number of bogs infested
Bees	Heavy
Ladybugs	Normal
Springtails	Normally abundant
Firebeetle	None found
Cranberry sawfly	Light infestation on several bogs
Red mite	Light

(*Compiled by H. J. Franklin*).

Plot work with several of the newer chlorinated hydrocarbons showed considerable promise for controlling cranberry root grubs. Though further testing of timing, rate, method, and most efficient formulation for use is still needed, sufficient kill of grubs with aldrin, dieldrin, endrin, isodrin, and heptochlor, at the rate of 10 pounds of actual toxicant per acre, was obtained when applied with emulsion concentrate form in 1000 gallons of water per acre to warrant much further testing.

Plot work with malathon indicates this material has a wide range of usefulness for controlling cranberry insects. One-half pound of actual malathon in 100 gallons of water gave 100 percent kill of Cerococcus scale crawlers, and three-quarters of a pound of actual malathon in 100 gallons of water was 100 percent effective in controlling black-headed fireworms, blunt-nosed cranberry leaf-hoppers, and cranberry spittle bugs.

Blunt-nosed cranberry leafhoppers resistant to DDT have been encountered with disturbing frequency where no appreciable reduction of leafhoppers resulted with ground spray applications of DDT at the rate of 1 and 2 pounds of actual DDT per 100 gallons of water, applied at 400 gallons per acre. Methoxchlor 25 percent emulsion concentrate at 2 quarts per 100 gallons, perthane 50 percent emulsion concentrate at 2 quarts per 100 gallons, malathon 25 percent wettable powder at 2-½ pounds, and malathon 50 percent emulsion concentrate at 1-½ pints per 100 gallons killed 100 percent of the leafhoppers in adjacent plots. A 5 percent malathon dust applied at 50 pounds per acre, applied by helicopter, was also 100 percent effective, whereas neither 5 or 10 percent methoxychlor dusts reduced the leafhopper population appreciably.

—*W. E. Tomlinson, Jr.*

Blueberry Insects. The cherry fruitworm, *Grapholitha packardi* Zeller, hitherto unreported from Massachusetts was found to be widely

distributed in damaging numbers in many southeastern Massachusetts cultivated blueberry fields. This blueberry pest, with habits similar to the cranberry fruitworm, not only destroys fruit on the bushes, but is often present in picked fruit when they go to market, thus spoiling their acceptance by the consumer.

The grubs of an undetermined weevil were found infesting green blueberry fruit in several cultivated blueberry fields. Alone, it appeared to be of little consequence, but the number of fruit it destroys combined with those eaten by cranberry and cherry fruitworms could very well be serious. Further observation and means of controlling these pests will be made.

—W. E. Tomlinson, Jr.

Beach Plum Insects. Both plum curculio and plum gouger destroy large quantities of beach plums in southeastern Massachusetts. Spraying experiments are underway to develop methods for controlling these insects.

—W. E. Tomlinson, Jr.

Strawberry Insects. Following a series of mild winters, strawberry weevils appeared in destructive numbers in several fields in the Falmouth area. Timely sprays of either DDT or methoxychlor 50 percent wettable powder, at 2 pounds in 100 gallons of water, gave effective control.

Red spider, *Tetranychus bimaculatus*, were present in damaging numbers in the Spring of 1953. Effective control was obtained with 15 percent wettable powder Aramite and 50 percent wettable powder Ovotran sprays, at the rate of 2 pounds per 100 gallons of water, with no injury to strawberry plants.

Strawberry aphids were eliminated with malathon 25 percent wettable powder sprays using 2 pounds in 100 gallons of water, and with a 50 percent emulsion concentrate at one pint per 100 gallons of water. A high kill of active red spider was obtained with the malathon sprays, but a rapid reinfestation resulted from subsequent hatching of eggs on the sprayed plants.

—W. E. Tomlinson, Jr.

Soil Water Studies. Many cranberry bogs are poorly drained because little or no water will pass through the peat and/or the sand is too fine to permit water movement. Poorly drained bogs often have many weeds, are more likely to have rot, and generally do not produce as well as bogs with good drainage. Experiments have been planned to use plastic tubing pulled into the ground with a mole plow. Preliminary studies indicate the mole plow will do little damage.

—F. B. Chandler and W. G. Colby.

Salt in Cranberry Soils and Flood Water. Three bogs with fairly large areas of dead vines have been studied during the past year. One of these was flooded with salt water during the hurricane of 1938 and still has some salt (NaCl). Another was not flooded during the hurricane but has a higher salt content (based on chlorine determination).

A third bog has salts or chemicals from a chemical dump. All these bogs are losing more vines each year, and it appears that the concentration of salt is increasing at the surface because there is poor drainage. Iron bacteria and algae seal the soil surface, so that most of the rain runs off, and later evaporation brings more salt to the surface. The salt at the surface may be reduced if drainage can be improved.

—F. B. Chandler.

Root Studies. The depth of rooting of cranberries varies from bog to bog, and within a bog there may be considerable variation. In general, the deeper the drainage, the deeper the roots; the deeper the roots, the larger the crop and the less damage at harvest. In several bogs studied the roots from runners were in the top half inch. In one of these bogs in a small section near a ditch and slightly higher, roots from runners were found to penetrate 3 to 4 inches. New roots started to develop at the State Bog April 12, 1952 (the bog was out of water most of the winter).

—F. B. Chandler.

Fertilizer Studies. The fertilizer studies in 1952 consisted of applications of soluble fertilizer in the insect sprays. These studies indicate that up to 33 pounds of nitrogen per acre from urea may be applied with the DDT spray. Superphosphate at the rate of 66 pounds of P_2O_5 per acre may be added to the spray which gives a 1-2-0 ratio. Saturated solutions of urea, monoammonium phosphate, diammonium phosphate, and urea ammonium nitrate (Uran 32) applied at rates to give 30 pounds of nitrogen per acre did not burn the tender foliage just before bloom.

—F. B. Chandler.

Cranberry Breeding. Of the one hundred and fourteen selections being grown in Massachusetts, sixteen have been chosen for further study. In addition, selection "31" has been distributed to a number of growers for tests in square rod (or larger) plots. The distribution of the selections to growers is being handled by a committee of The Cape Cod Cranberry Growers' Association.

—F. B. Chandler in cooperation with J. F. Bergman, U.S. Department of Agriculture.

The Effect of Container on the Quality of Cranberries. In cooperation with the New England Cranberry Sales Company, a study of the effect of container on the quality of cranberries was made in the Fall of 1951 and 1952. The 1952 study indicated less spoilage of cranberries in ¼-barrel boxes than in consumer packages. The amount of spoilage of the cranberries packed in Cellophane bags differed slightly from that in the window boxes. The loss in weight of the fruit packed in window boxes was greater than that packed in Cellophane bags. Comparison of results of studies on fruit taken from one bog in each of two years suggests that local soil and environmental conditions may affect fruit maturity and condition, which will later be reflected in its keeping quality.

—F. B. Chandler.

DEPARTMENT OF DAIRY INDUSTRY

D. J. HANKINSON IN CHARGE

Sanitizing Agents for Dairy Use.

1. *Germicidal Effect of Quaternary Ammonium Compound Against Pseudomonas Aeruginosa. Pseudomonas aeruginosa* is receiving much attention in connection with the control of mastitis. There are conflicting reports in the literature on the effectiveness of quaternary germicides in destroying this organism. The germicidal property of a 200 ppm quaternary solution was determined for 31 strains of *P. aeruginosa*. Complete kill was obtained in 13 strains after 30 seconds contact and in 20 strains after 1 minute contact. When this same quaternary was added to detergents, complete kill was obtained for all 31 strains after 30 seconds contact. Although quaternaries in general exert a greater germicidal action at an alkaline pH than in the acid range, the increase in germicidal action of the detergent-sanitizer cannot be explained on the basis of pH alone. It is due probably to a synergistic action of certain detergent compounds, which are being investigated further.

2. *New Developments in Washing Cows' Teats, Udders, and Flanks.* The general recommendation today is to use individual paper towels for washing cows before milking, so as to minimize the spread of mastitis. A cotton fiber cloth, impregnated with a quaternary germicide, is now available for use in place of the paper towels. One cloth placed in 10 qts. of water is claimed to give a solution containing at least 200 ppm of quaternary. The manufacturer recommends that the cloth be returned to the germicidal solution each time before washing the next cow, and that a fresh solution be prepared, when needed, by adding a new cloth to clean water.

A check on 24 cloths (1 cloth to 10 qts. of water) showed that the average amount of quaternary in solution from each cloth to be 220 ppm (± 7.4 ppm). Rate of solution of quaternary from the cloth into the water was also checked. In order to obtain a 200 ppm solution in 30 seconds, it was necessary to squeeze the cloth out by hand at least once. The destructibility of the wash cloth and the stability of the germicidal solution were studied at various dairy farms. At one farm a new cloth was not needed until after washing 30 cows, whereas at another farm a new cloth was necessary after washing 7 cows. The number of cows that can be washed with one cloth depends upon the person doing the washing and also upon the amount and kind of soil to be removed.

3. *Iodine as a Sanitizing Agent for Dairy Use.* The high germicidal potency of elemental iodine has been known for a long time. Its use, however, in food industries has been limited because of its corrosiveness, instability, toxicity, and other limitations. Now, it is known that various surface active agents will solubilize iodine, forming a loose chemical combination called an iodophor. Since surface active agents differ from each other with respect to the degree of their reactivity with iodine and their synergistic action, considerable variation in the resulting iodophor is to be expected.

Various combinations of surface active agents and iodine are being investigated in this study. Some iodophor compounds have

been found to be rather stable, are effective in a concentration as low as 2.5 ppm, and are not affected adversely by hard water as are the quaternaries. These new sanitizing agents appear to have potentalities for use on dairy farms and in dairy plants.

—W. S. Mueller.

Antioxidants of Cacao Origin for Dairy Products.

1. *Effect of Cacao Shell on the Stability of Milk Fat.* Earlier research work (1938) in this laboratory showed that cacao shell contains constituents that are effective as antioxidants for milk fat. Cacao shell was fed to a cow to determine whether or not these antioxidants would have any effect on the milk. The results obtained showed that 2.5 percent cacao shell added to the grain mixture increased the resistance of the milk fat to oxidative deterioration.

—W. S. Mueller and K. Blazys.

2. *Antioxidants Isolated from Cacao Shell.* Several polyphenolic fractions have been isolated from the water or alcohol extract of cacao shell. The identification of these polyphenolic fractions was tentatively established by means of paper partition chromatography and conventional chemical methodology. It was found that 0.01 percent concentration of two of these fractions compared favorably with a suitable commercial antioxidant when evaluated in butter oil.

—W. S. Mueller and E. J. Finnegan.

3. *Thiobarbituric Acid (T.B.A.) Test for Determination of Oxidative Spoilage in Milk Fat.* The search for better chemical methods for measuring oxidative deterioration in fats is continuous. The Peroxide Value Test has been for many years the most commonly used test for measuring oxidative spoilage in fats.

Recently a new test called the Thiobarbituric Acid (T.B.A.) Test has been developed. The study here reported deals with the evaluation of the T.B.A. test for measuring oxidative spoilage in milk fat. The T.B.A. test was found to be more sensitive than the Peroxide Value test, especially during the early stages of the oxidation period. Also, the T.B.A. test results correlated closely with organoleptic scores of milk samples having oxidized flavors of varied intensities. The sensitivity of the T.B.A. test was unaffected by such factors as acidity, temperature, homogenization of milk, and presence of antibiotics and quaternaries in milk.

—W. S. Mueller and K. Blazys.

The Effect of Added Heated or Homogenized Milk on Delaying the Development of Oxidized Flavor. This study was made in an attempt to utilize the knowledge that the homogenization of milk and the heating of milk to high temperatures will retard the development of oxidized flavor. It was found that the addition to susceptible milk of 1 percent of milk heated to 180 to 190°F. would reduce the intensity of the flavor but would not entirely eliminate it. Increasing the levels of addition to 2 percent gave no more protection than the 1 percent addition. Homogenization of the antioxidant milk preparation did not

increase its antioxidant properties. Levels of addition were limited to 2 percent or less because it was felt that it would be impractical to prepare larger amounts for use in commercial milk plants.

— *D. J. Hankinson and W. E. Hobbs.*

DEPARTMENT OF ECONOMICS

PHILIP L. GAMBLE IN CHARGE

Public Land Ownership in Rural Areas of Massachusetts. In considering the character and extent of public land ownership in rural areas and its effect on agricultural land utilization, further progress has been made in securing the necessary data for both state and local holdings. Of special significance has been the determination of watershed areas reserved under public ownership for water supply systems of the cities and towns of the Commonwealth. Preliminary data indicate that more than 75 percent of the towns have some areas reserved for water supply systems, either their own or those of other municipalities. Incomplete figures indicate that over 155,000 acres in various watersheds are under public ownership for this purpose. About one quarter of this is for the Boston Metropolitan area, and more than one-half for the other cities in the State.

The road system in rural areas is another important factor of public land ownership and public facilities for which detailed data were worked out. Relating the mileage of roads to the area of the towns, it was possible to classify them on the basis of the available road facilities. Of the 312 towns in the State, 61 towns, largely in the western part of the State, have less than 3 miles of roads per 1,000 acres, whereas the upper group of 52 towns, mostly in the eastern part of the State, has more than 6 miles of roads for the same area.

To determine the extent to which large areas of publicly-owned land are being improved by soil conservation practices, detailed figures were obtained from the Soil Conservation Service. Up to the end of 1952, 30,269 acres of land under various types of public ownership were mapped for conservation practices. The most important practices introduced, taken separately, involved 2,192 acres in connection with crop and hay land. Pasture improvement, including management, seeding, and clearing, covered another 2,187 acres. Other improvements in mapped areas included drainage, irrigation, ponds, and preservation of woodland and of wild-life areas.

— *David Rozman.*

DEPARTMENT OF ENTOMOLOGY

CHARLES P. ALEXANDER IN CHARGE

Investigations on European Corn Borer Control. The Fall and Winter of 1951-52 proved highly favorable for corn borer survival, with almost no evidence of winter mortality. Spring pupation and moth emergence was somewhat retarded by consistently cold weather. Prevailing weather conditions affected growth of corn also so that moth emergence and egg laying occurred at approximately the normal stage of corn plant development. As might be expected, damage to early market sweet corn from first brood larvae was greater in the State than in 1950, and second brood injury was materially greater.

First hatching of eggs was approximately June 15 to 16 on the basis of masses collected in the field. On the basis of our data and similar observations by Dr. Wheeler, the schedule for insecticide application was begun as of June 16 in this area with some adjustments for local conditions in other parts of the State. Results indicated the estimate was accurate. A schedule of three applications at 7-day intervals was followed. Four sprays and five dusts were applied. Three formulations of Ryania and activators were included in the spray plots. Four similar Ryania dust formulations were used. DDT was used as a basis of comparison in both spray and dust plots.

Counts of tassel breakage were made just previous to harvest. In both sprayed and dust plots, plants were 99 to 100 percent clean. In check plots 74 percent of the tips were clean. In other untreated areas in the field similar counts showed 72 to 74 percent uninfested tassels. The records for 1500 ears of harvested corn showed 5.8 borer infested ears per 1000 in the check plots. The second picking showed 3.6 infested ears per 1000 in treated areas compared with 79.3 in check plots indicating the rapid deterioration in quality from continued attack in the untreated corn. Records of total yield were somewhat complicated by indiscriminate attack of skunks or raccoons from adjoining woods. Even in the face of a comparatively light attack the loss in marketable corn is significant.

—*A. I. Bourne.*

Control of Pear Psylla. Orchard tests of toxaphene emulsion and of Dilan dry wettable powder in the variety pear block resulted in effective control of Pear Psylla when these materials were applied at peak appearance of the young first brood nymphs.

Both of the materials showed excellent initial kill and appeared to have good residual action. On the basis of the results this season these materials promise a satisfactory control of the pest and offer no hazards to the operator and no danger of residue on fruit at harvest. Further tests in 1953 are planned.

In 1952, tests of Dilan (25 % wettable powder) at 3 pounds per 100 gallons and of toxaphene (60 percent emulsion) at 1 quart per 100 gallons were made in the variety pear orchard. The materials were combined with Methoxychlor and fungicides in the first cover spray where a few Psylla adults were still present, and young nymphs were plentiful.

Counts a few days later showed 505 Psylla nymphs per 50 clusters on unsprayed trees, and 28 per 50 clusters on trees sprayed with Dilan. No live nymphs were found on toxaphene-sprayed trees.

A week later, similar counts showed 196 nymphs per 50 clusters on check trees, 6 on Dilan-sprayed trees, and only an occasional nymph where toxaphene was applied.

A third count made a week later showed 850 Psylla nymphs per 50 clusters on the checks, 20 on the Dilan trees, and none in the toxaphene sprayed area. No further applications for Psylla control were necessary.

By mid-July no further increase in Psylla infestation had occurred on the sprayed trees.

The tests showed effective control of Psylla after one application of both Dilan and toxaphene properly timed to contact the peak of appearance of first brood nymphs. No significant build-up occurred during the rest of the season. At the same time a continuous and rising infestation was occurring on unsprayed check trees in the same orchard. Both of these materials offer no particular operational hazard to the growers, and, as applied, no danger of residue at harvest.

—*A. I. Bourne.*

Potato Spraying Experiments. The potato test plots were planted May 1. Cold wet weather during the month somewhat retarded germination and subsequent growth. By early June the stand was very uniform but not as advanced as usual. The plants averaged 4 to 6 inches in height by June 11, when the first spray was applied.

From that date until September 16, the plots were given 15 applications. Those in September were fungicides only to protect new growth and were made in consequence of prevalence of late blight in certain sections of the valley and in near-by areas.

Early flea beetle attack was light and readily handled by DDT in the early sprays. The second brood began to develop by early July and DDT in mid-July sprays reduced them to a minimum. Leafhoppers and plant bugs were of no significance at any time during the season.

Potato aphids were becoming numerous by mid-July and threatened a serious infestation. TEPP in the July 22 spray almost eliminated them for the season.

There was no evidence in the test plots of flea beetle resistance to DDT. Counts from field collections after late July sprays with DDT showed a reduction in population of 94 to 95 percent from the insecticide.

Yields in the test plots reflected general conditions in the region being considerably lighter than normal.

Differences in yield were not enough to show great significance. Again, however, plots in which DDT was added in every spray showed greater yield than plots where DDT was added only at peak abundance of the pests. Yield in the neutral copper sprayed pot ran nearly as high as in the Bordeaux-DDT plot, and the quality of the crop was somewhat superior.

—*A. I. Bourne.*

Control of Onion Thrips. Throughout the Connecticut River Valley the early season was favorable both for the growth of the onions and apparently for the thrips. The insects appeared earlier than usual and

the attack developed steadily through May to threaten dangerous proportions by late June and early July. Altogether the infestation was considerably heavier than usual.

In the test plots, sprays of chlordane, aldrin, dieldrin, malathon emulsion, and nicotine sulfate gave almost a perfect kill of thrips on all parts of the plants within 24 hours. Toxaphene and DDT were slightly slower in their initial action but were eventually equally effective.

Inspection of plots after a 7-day period showed almost no thrips after chlordane, aldrin, dieldrin, toxaphene, and DDT application. Substantial reinfestation was noted after application of nicotine sulfate, and on the Malathon-sprayed plants the thrips population built up rapidly.

Ryania gave fair immediate control, but its effect was soon dissipated. A new material, Dilan was very slow in its initial effects and, was fairly effective for a week's time, but its effect was lost thereafter.

Very little reinfestation was noted after chlordane, aldrin, and dieldrin after a two-week interval, whereas toxaphene and DDT were only slightly less effective. Aldrin and dieldrin seemed equally effective in both wettable powder or emulsion formulations.

Observations in commercial plantings in cooperative tests between growers and a graduate student indicated that malathon (emulsion), chlordane, lindane, and toxaphene (emulsion) gave excellent initial kill in spray applications holding the insects to a range of 7 to 50 thrips per 20 plants as compared with 798 on adjoining unsprayed checks. Heptachlor dust was much less effective (180 per 20 plants compared with 634 on adjoining checks).

After 7- to 10-day interval, chlordane, lindane, and toxaphene had allowed only a slight re-infestation (39 to 110 per 20 plants compared with 1065 on checks). Malathon showed only slight residual effects, and its initial effects apparently soon disappeared. This material as constituted furnished an almost perfect quick kill, but is not designed for long residual action.

—*A. I. Bourne.*

Insects in Relation to Forage Crops in Massachusetts. During the past season, work was begun on studies of the insect pests of forage crops in the State. A survey was initiated to determine the insects present in alfalfa and clover plantings and to indicate the relative seriousness of their attack. Studies of seasonal distribution of the more important species were begun. The record of this first season indicated that almost all the major orders of insects were represented in the collections made, but spittlebugs and the potato leafhoppers were the leading pests in point of potential damage to the crop. Lygus bugs, aphids, and grasshoppers were present in considerable numbers, but their abundance varied greatly in different fields, and they were not generally present in sufficient numbers in the Summer of 1952 to require special control measures.

Preliminary tests to determine toxicity of methoxychlor and toxaphene indicated reasonably good control of spittlebugs if applied early in their attack in the spring.

—*F. R. Shaw and A. I. Bourne.*

Control of Cabbage Maggot. In 1953 the natural infestation in replicated plots in the experimental planting caused 76.67 percent commercial injury. Under these conditions dust treatments in the field gave 100 percent protection with two applications of 5 percent chlordane dust and 1 percent lindane dust, but only 85 percent protection from one application. Field-applied drenches of corrosive sublimate 1-1280 were 100 percent effective in two treatments and 93.3 percent in one treatment. A commercial transplanter solution containing 5 percent lindane at 4 ounces to 50 gallons gave 97 percent protection with two applications but only 70 percent control with one treatment.

Drenches of insecticides were applied one day before transplanting to flats of cabbage plants with and without plant bands at the rate of 2 quarts per flat of 66 plants. Each of the formulations gave complete or nearly complete protection without further treatment in the field, but the wettable powder suspensions were slightly more effective than the emulsifiable concentrates. The formulations were -

50% chlordane wettable powder	— 2 pounds	in 50 gallons of water
25% dieldrin wettable powder	— 2 pounds	
23% aldrin emulsifiable concentrate	— 1 quart	
74% chlordane emulsifiable concentrate	— 4 ounces	
18½% dieldrin emulsifiable concentrate	— 1 quart	

—W. D. Whitcomb and W. J. Garland, Waltham.

Apple Maggot Control. Apple maggot flies emerged normally in 1952 but continued active later than usual and were very destructive. In cages placed under orchard trees where the flies were exposed for 24 hours after emergence to the residue of insecticides applied to the trees, 94.36 percent of the flies were dead from 1 pound per 100 gallons of dieldrin 25 percent wettable powder; 89.48 percent following methoxychlor 50 percent wettable powder, 2 pounds plus lead arsenate 1 pound per 100; 75.39 percent in the methoxychlor 25 percent emulsifiable concentrate, 3 quarts per 100 treated plot; and 77.5 percent where EPN, an organic phosphate, at 1½ pounds per 100, was used. These residues killed the flies for the first 10 days after application but permitted 20 to 30 percent survival during the next 5-day period.

—W. D. Whitcomb and W. J. Garland, Waltham.

Control of Plum Curculio in Apples. In laboratory poison studies five pairs of beetles confined with unsprayed apples averaged 26.6 punctures per day for 20 days. Under these controlled conditions 50 percent methoxychlor wettable powder killed the beetles in a minimum time (3 to 5 days) and allowed a minimum number of punctures in the apples at 2, 3, and 4 pounds per 100 gallons, but was ineffective at a dosage of 1 pound per 100 gallons. A 24 percent methoxychlor emulsifiable concentrate was effective at 2 and 3 quarts per 100 but not at 1 quart per 100. Five combinations of methoxychlor and lead arsenate killed the beetles with a minimum of punctures in the apples and showed clearly that methoxychlor was the most toxic of these materials.

Dieldrin 25 percent wettable powder at 1, 2, and 3 pounds per 100 and 18 percent dieldrin emulsifiable concentrate at 1, 2, and 3 quarts were the most effective of the insecticides evaluated and showed no significant difference among the concentrations tested. TDE 50 percent wettable powder at 1, 2, 3, and 4 pounds per 100 was ineffective in all

In orchard tests 50 percent methoxychlor wettable powder gave excellent control in all formulations used. It is noteworthy that there was no significant difference in effectiveness between a dosage of 3 pounds and 2 pounds per 100 gallons and between a combination of 2 pounds with 1 pound of lead arsenate and with 2 pounds of lead arsenate. Methoxychlor emulsion was less effective than the wettable powder formulation and caused slight injury to the foliage. Lead arsenate failed to give adequate protection. Dieldrin as a 25 percent wettable powder gave good control under difficult conditions and was outstanding considering the small amount of toxicant used. Organic phosphates in the form of EPN 300 and Metacide in the experimental orchard and as Parathion and ET 30 in a grower's orchard permitted 13 to 17 percent stung fruit and were significantly less effective than methoxychlor or dieldrin.

—W. D. Whitcomb and W. J. Garland, Waltham.

Control of Injurious Insects and Mites in the Greenhouse With Aerosols. Previous experiments with aerosols have shown that injury to greenhouse plants from these materials are most likely to occur at extremes of temperature above or below 60 to 80°F. and above or below relative humidity of 50 to 80 percent. Experimental treatments with new aerosols containing 10 percent Malathon (a dimethyl thiophosphate) plus 5 percent Aramite (a chlorobenzene sulfonate) with 15 percent Malathon and with 10 percent plus 2 percent lindane (gamma isomer of BHC) showed no injury to carnations within these atmospheric ranges. On cucumbers slight injury in the form of pinpoint spots on the leaves resulted.

One application of these aerosols was 15 to 20 percent less effective against the red spider mite than similar treatments with parathion or dithiophosphate.

—W. D. Whitcomb and W. J. Garland, Waltham.

Biology and Control of Grape Cane Girdler. Girdled canes and other activity were first observed on May 28 when high temperatures occurred and continued almost continuously until June 27. Among 347 girdled canes observed, the average number of cuts per girdled cane was 2.89 varying from 1 to 5. Sprays were applied May 29, June 2, 8, and 18. Lindane 25-1-100, dieldrin 25-1-100, methoxychlor 50-2 plus lead arsenate 2-100, and methoxychlor 50-3-100 were effective, but TDE 50-3-100 was unsatisfactory. The effective sprays gave protection for 6 to 8 days in spite of heavy rains within two days of application.

—W. D. Whitcomb, Waltham.

Ecology and Control of Common Red Spider on Greenhouse Plants. The systemic insecticide, Systox (0-0-diethyl 0-2-ethyl-

mercaptoethyl thiophosphate) diluted 1-32,000 in water was applied at the rate of 1 quart per square foot to greenhouse roses in two series of experiments. All plants were uniformly infested on November 21, 1952, with 120 common red spider mites on each plot of eight plants. In one series, Systox was first applied on the same day (Nov. 21) that the plants were infested; in the other series, Systox was applied for the first time when the spiders were thoroughly established (Dec. 30). Thereafter, treatments were made to plots in each series at intervals of two, four, and six weeks.

Counts at intervals of two weeks from Dec. 30 to Mar. 12 showed no spiders on the plants where the insecticide was applied at the time of infestation regardless of the interval between treatments. On the plants having an established infestation of mites (12 to 19 per leaf) when the treatment was first applied, the infestation was reduced about 90 percent in two weeks and completely eliminated in 10 weeks following treatments at two- and four-week intervals. Two treatments at six-week intervals permitted 0.6 spider per leaf at the last observation. On untreated checks, the spider population increased steadily to 83.6 mites per leaf when most of the leaves were badly damaged so that the infestation dropped to 48.6 mites per leaf. About four weeks after the Systox was first applied, injury in the form of spotted variegated foliage developed. Apparently this is associated with reduced daylight and has not been observed in summer.

—*W. D. Whitcomb and W. J. Garland, Waltham.*

Control of Insects on Cucurbits in Relation to Yield. Methoxychlor, rotenone, and lindane dust were applied to cucumbers and melons and various formulations of lindane dust were applied to summer squash, Buttercup and Blue Hubbard squash. Records were taken for insect control, yield and taste contamination.

Insect Control. On cucumbers and melons all dusts eliminated the striped cucumber beetle and prevented reinfestation for five days. In 8 to 10 days a very light reinfestation occurred on plants dusted with lindane, a moderate reinfestation where methoxychlor was used, and a heavy reinfestation following rotenone. Infestation by the melon aphid developed more quickly and heavily after an application of methoxychlor than after an application of rotenone or lindane.

On summer squash three or four applications of all dusts (lindane 0.125, 0.25, 0.50 and 0.75 percent) gave complete or nearly complete protection against the squash vine borer. One and two applications permitted an infestation of 1.14 to 2.85 borers per vine. The dust containing 0.75 percent lindane was about twice as effective as the less concentrated dusts, but none of the injury was great enough to affect yield or quality.

On Buttercup and Blue Hubbard squash, all dusts gave complete protection from borer injury compared to an average of 6.7 and 3.2 borers per vine in untreated plots. The complete control obtained with one or more applications of dust containing only 0.125 percent lindane further emphasizes the effectiveness of this insecticide against the squash vine borer.

Yield. The yield of melons and cucumbers on the untreated vines was far below that of the dusted vines, but there was no significant

difference in yield among the vines dusted with methoxychlor, rotenone, or lindane.

On summer squash the yield was taken for one month, July 17 to August 18. There was no consistent difference in yield that could be related to the amount of lindane in the dust or to the number of applications. On Butternut squash the yield was consistent among the untreated vines and those dusted with the different concentrations of lindane. However, there was a significantly greater yield after one application than after two applications. The yield of Blue Hubbard was high in all plots but extremely variable and showed no connection with the dust treatment.

Taste Tests. Taste tests were made by the Department of Food Techonolgy under the direction of Dr. W. B. Esselen, Jr.

In these tests only the melons were not significantly affected by lindane dust. On pickles, 75 percent of the tasters reported slight or marked off-flavor, and 40 percent on slicing cucumbers.

On summer squash a dust containing 0.75 percent lindane caused greater taste contamination than those with smaller amounts of the insecticide. The greatest difference was in the number of days between application and harvest or testing. With the lower concentrations of lindane dust, very little off-flavor was found 21 and 28 days after application.

On Buttercup squash the majority of the tasters reported normal taste at the lower concentrations but marked off-flavor on the others.

On Blue Hubbard which was harvested 10 to 14 weeks after the last application of dust, taste contamination was reported in all the samples. A greater amount of lindane in the dust did not cause proportionately greater contamination, but 3 and 4 applications were the worst. A special highly refined lindane dust was not signifiacntly better in this respect.

—W. D. Whitcomb, Waltham.

Use of Systemic Insecticides to Control Insects on Ornamental Trees and Shrubs. Preliminary tests with 50% Systox emulsion showed 95% or more of the birch leaf miners killed in 7 to 21 days after soil applications at 1-550, 1-1100, and 1-2200. Parathion was ineffective in a soil treatment, and Systox 1-2200 applied as a spray was effective for seven days only.

Spray applications of Systox to elms infested with Japanees beetles and to Norway spruce infested with spruce gall aphid had no apparent effect as used.

—Fred O. Ames.

Effect of Pesticides on Beneficial Insects. The residues of five spray formulations containing methoxychlor produced 100 percent mortality to the red mite destroyer *Stethorus punctum* and from 86 to 100 percent to an aphid-eating lady beetle. Residues from eight other pesticides at recommended dosages gave a wide range of mortalities; Fermate, Aramite, DDD, dieldrin, and lead arsenate were low; DDT was moderate, and parathion high. Direct application of five methoxychlor formulations caused 100 percent mortality to lady beetles,

whereas dieldrin and lead arsenate produced none. Orchard applications of dieldrin, lead arsenate, and Fermate did not cause an appreciable reduction of the red mite destroyer.

—*John A. Weidhaas, Jr., Waltham.*

Control of Insect Pests of Ornamental Plants. To meet the demands of town tree wardens, moth superintendents, and commercial arborists for information about the control of insect pests of trees, work on this project has been directed toward studying the effectiveness of the newer insecticides against such pests and also toward learning whether the insecticides would injure the plants in any way.

Insect Control Tests. (With hydraulic sprayers.) The quantities of insecticides given in parentheses are the amounts used per 100 gallons of water.

Dormant Applications

Euonymus scale: Good control resulted from an application of DN289 (2 quarts).

Snowball aphids: Complete control resulted from an application of DN289 (2 quarts).

Foliage Applications

Birch leaf miner: In preliminary tests promising control was had with the following sprays: A 50 percent methoxychlor wettable powder (2 pounds); an 18.5 percent aldrin emulsion (0.25 and 0.5 pints;) and an 18.5 dieldrin emulsion (0.25 and 0.5 pints).

Eastern tent caterpillar: In preliminary tests, good control was had with the following insecticides: a 25 percent Dilan emulsion (1 and 2 pints); a 25 percent methoxchlor emulsion (1 and 2 pints); a 25 percent Rothane (DDD) emulsion (1 and 2 pints); a 60 percent toxaphene emulsion (0.5 and 1 pint); an 18.5 percent dieldrin emulsion (0.25 and 0.5 pints); an 18.5 percent aldrin emulsion (0.25 and 0.5 pints); an 18.5 percent 269 (Endrin) emulsion (0.25 and 0.5 pints); an 18.5 percent 711 emulsion (0.25 and 0.5 pints); a 25 percent Q137 emulsion (1, 2, and 3 pints), and a 15 percent gamma BHC emulsion (1 and 2 pints). The aldrin and toxaphene sprays acted slower than the rest.

Elm leaf miner: Excellent control was had with a 12 percent gamma BHC wettable powder spray (1 pound). Promising control was had with a 50 percent methoxychlor wettable powder spray (2 pounds).

Elm defoliators: In an experimental control operation with American elm trees, defoliation was rare on American elm trees sprayed with a 24 percent methoxychlor as follows: A prefoliar application (8 gallons) for a Dutch elm disease prevention test; June foliage application (1 quart) for elm leaf beetle grubs; and a July foliage application (2 quarts) for adult Japanese beetles. However, several sprayed Chinese elms, which are favored food plants of the Japanese beetle, were severely defoliated in July and August. Unsprayed American elms were moderately to severely defoliated at the end of the season. American elms sprayed in the same proportions and at the same times with DDT looked about the same as the methoxychlor sprayed elms. Two mites, *Tetranychus bimaculatus* and *T. canadensis* became abundant on all the sprayed elms.

Spruce mites: A 60 percent toxaphene emulsion (2 quarts) and a 15 percent Aramite wettable powder (1.5 pounds) each gave good control. A 25 percent 338E emulsion (1 quart and a 50 percent Genite EM923 emulsion (1 quart) each gave a rapid kill of active mites but seemed less effective against eggs. A 50 percent Ovotran wettable powder (1.5 pounds) gave considerable reduction of mites. Promising control was had with an 80.7 percent Chem-Mite emulsion (1 quart), and also with a Pyrenone CPR (T313A) emulsion (2 quarts).

Spray Injury Tests. (With hydraulic sprayers.) The following insecticides were used on many broad-leaved plants and a few needle-leaved plants without noticeable spray injury to foliage. (The amount of insecticide per 100 gallons of water, and the air temperature and relative humidity at the time of application are given in parentheses.)

Dormant applications: Elgetol (1 gallon, 67°., 19 percent); Elgetol 318 (2 quarts, 61°F., 40 percent); and Krenite (2 quarts, 54°F., 42 percent). However, when the foregoing DN sprays were applied after plant growth began, severe spray injury usually resulted. A superior oil (2 gallons, 59°F., 38 percent).

July foliage applications: A 50 percent Malathon emulsion (1 quart, 93°F., 40 percent); and a 25 percent Malathon wettable powder (2 pounds, 88°F., 51 percent).

—*W. B. Becker.*

Effectiveness of Benzene Hexachloride (BHC) Sprays Against Insect Pests of Unseasoned Logs and Dying Trees. In view of the excellent results obtained by the author with certain insecticides in preventing infestation of elm logs by the insect vectors of the Dutch elm disease fungus, work on this project has been directed toward learning whether such spray applications might also help prevent losses in the lumber and paper industries where sawlogs and pulpwood have been ruined or reduced in value by wood-boring insects. An interesting sideline has been the study of these insecticides for preventing these same borers from killing living ornamental pines.

Pine Boring Beetles: Studies in 1952 confirmed earlier work. (A) A 0.2 percent (by volume) gamma isomer content BHC emulsion applied once to all bark surfaces of individual logs (white pine) gave almost complete protection all season against round-headed borers, bark beetles, and bark weevils. Ambrosia beetles were too scarce in any of the logs, including the unsprayed checks, for a good comparative test with them. (B) Two gallons of a 0.4 percent gamma BHC emulsion applied at the same time to the outside of piles (one-half cord each) of red pine or white pine logs gave 97 to 100 percent protection against all four of the above groups of insects: one gallon at the same concentration gave 91 to 98 percent protection of a red pine log pile.

In a preliminary test, the trunks of living white pine trees were sprayed thoroughly with BHC emulsions containing 0.025 to 0.4 percent gamma content (by volume). Immediately afterwards they were killed by deep girdling. Better than 90 percent protection resulted in all cases under local beetle conditions. Complete protection resulted at 0.2 percent gamma content. In conjunction with this, other living red and white pine trees, not girdled, were completely sprayed with a

0.4 percent gamma BHC emulsion (diluted from a 15 percent gamma concentrate) without spray damage. This information may be useful in southeastern Massachusetts where complaints are made that native living pines left around new home building sites for ornamental purposes frequently succumb to these beetles. Only when such beetles are particularly abundant in a locality can they kill healthy pine trees. On Cape Cod, the frequent forest fires that kill many pines provide beetles with much breeding material. Consequently they become abundant. Many such beetles may be attracted to a construction site by cutting, trimming, or injury to a few trees or by the odor of new coniferous lumber; once there, they may proceed to attack near-by living pines.

Unfortunately, 0.2 and 0.4 percent gamma isomer BHC or lindane sprays (diluted from both 15 and 20 percent gamma emulsion concentrates) have occasionally injured the foliage of some broad-leaved trees when in leaf.

Oak Borers: Oak logs of cordwood size, individually sprayed like the previously mentioned white pine logs, required a 0.4 percent gamma BHC emulsion to give complete protection against ambrosia beetles, which were the principal pests present. BHC emulsions containing 0.05 to 0.4 percent gamma isomer (by volume) were tried. Neither round-headed borers nor bark beetles and almost no flat-headed borers were in any sprayed logs, and not enough were in the unsprayed checks for a good comparative test.

—*W. B. Becker.*

FEED AND FERTILIZER CONTROL SERVICES

JOHN W. KUZMESKI IN CHARGE

The feed, fertilizer, and milk testing laws are administered as one service. The operations of each, with the exception of the milk testing law, were calibrated, and 115 certificates of proficiency in testing were issued. All milk depots and milk inspection laboratories in the Commonwealth were visited at least once to check apparatus and general conduct of the work.

In addition to the regulatory work, the Feed and Fertilizer Control laboratories have examined feeds, fertilizers, and other agricultural materials for citizens of the Commonwealth without charge, whenever the results were considered of interest to the general public or to the Control Services.

Considerable work has been done on research projects in cooperation with other departments of the University and Experiment Station. The results of such work are reported by the departments originating the projects.

DEPARTMENT OF FLORICULTURE

CLARK L. THAYER IN CHARGE

The Effect of Nutrient Elements on the Growth of Roses. Grafted rose plants of the variety Better Times were grown in soil with three different rates of application of potassium. The treatments, consisting of nine replicates of each, were a manure mulch of 2-inch depth and potassium chloride applied at rates of 2, 3, and 4 pounds per 100 square feet of bench. One inch of the mulch was applied in September, 1950, and the second inch in March, 1951. Potassium chloride was applied in two treatments, one-half of the total quantity a month after planting in June, 1950, and the remainder in November, 1950. This is all the potassium the plants have received during the three years of culture.

Analyses show that before treatment the soil contained the equivalent of 268 pounds of potassium, and 1200 to 1500 pounds of calcium per acre. After the treatments were completed, periodic soil analyses during the first year showed a potassium range of 427 to 1020 pounds per acre. During the second year the range varied from 440 to 750 pounds per acre, and in the third year from 160 to 288 pounds per acre. Potassium, calcium and total nitrogen determinations were made on plant tissue from plants in all treatments.

To persons working with field crops the levels of potassium used in greenhouse culture would seem exceedingly high. From data obtained in 1951-53 in a commercial greenhouse range, when samplings of soil and plant tissue were taken monthly, the levels of potassium in the experiment would not appear to be unusual. In the commercial range from July, 1951, through March, 1953, the potassium level never dropped below 600 pounds per acre and ranged as high as 750 pounds per acre.

Monthly and yearly production of flowers varied with the treatments but not to the degree of being statistically significant. Differences in production, grades, and green weight of flowers and stems among the nine replicates in any one treatment were strikingly slight.

The experimental plots are being continued to determine how low the potassium level can become before production is affected.

—*Harold E. White.*

The Effect of Different Storage and Curing Treatments on Eucharis-Lily Bulbs. A six-year-old planting of Eucharis-lily bulbs in a commercial greenhouse was dug in July, 1952. The mother or center bulbs with the offsets removed were subjected to different storage and curing treatments to determine whether the time of flowering could be controlled.

The mother bulbs were graded to a size range of 1-½ to 1-¾ inches in diameter, then cured at storage temperatures of 70 to 100°F., 65 to 75°F., and 36 to 38°F. for intervals of 7 to 28 days. Other bulbs were given warm storage at 70 to 100°F., followed by cool storage at 36 to 38°F. In these treatments all mature foliage was removed, leaving only one or two immature leaves. Other bulbs were stored without the removal of the foliage. Additional bulbs were sized and weighed to determine the relation between size, weight, and time of flowering. Bulbs were graded from 1-⅛ to 2-¼ inches in diameter, with weights ranging from 0.87 ounce to 2.50 ounces.

Storage treatment for 7 to 21 days at 70 to 100°F. resulted in a loss of weight of 31.6 to 39.0 percent; at 65 to 75°F., 14.0 to 14.5 percent; at 36 to 38°F. for 14 to 28 days, 17.9 to 23.1 percent.

Storage and curing treatment at 65 to 70°F. and 70 to 100°F. did not affect flowering or vegetative growth. Bulbs given storage at 36 to 38°F. immediately after harvest showed retarded leaf growth and increased bulb production. Storage at 70 to 100°F. prior to cool storage did not nullify the influence of the cool temperature.

The removal of foliage from bulbs prior to storage or replanting did not affect growth or flowering.

Observations on replantings of bulbs at the commercial greenhouse (source of the experimental bulbs) show that some bulbs flowered a second time during the year, from May to June. Based on flower production records, it is estimated that 15 to 20 percent of the total replantings flowered a second time. The interval between the first and second flowerings may vary from four to six months.

Recurrent flowering appears to be regulated by inherent characteristics of the individual bulb. On the basis of present information the control of initial and recurrent flowering by the use of specific storage and curing practices has not been satisfactorily demonstrated.

—*Harold E. White.*

Treatment of Greenhouse Rose Soil with Synthetic Soil Conditioners. Rose soil that had been cropped to roses for 11 years was treated with two soil conditioners, one containing 40 percent and the other 25 percent of active material. Two rates of application were used with each treatment: a low rate of 0.40 pound of active material, and a high rate of 2.0 pounds per 100 square feet of bench area with 6 inches of soil. These rates of application were used as follows: 1) on unsteamed soil with and without the addition of manure, 2) applied prior to steaming the soil, and 3) applied after steaming was completed. On an adjoining bench of 240 linear feet, 1 inch of sand and 1 inch of peat were added to the 4 inches of soil, followed by steaming, the purpose being to compare this treatment with the use of synthetic soil conditioners.

Eighty plants of the rose Better Times were grown in each plot of 70 square feet. The pH of the soil at the beginning of the treatments varied from 6.0 to 6.5. Treatments were started on June 9, 1952, and observations will continue for three to four years.

Data at present show no differences in growth response of the plants or in the compacting of the soil in the different treatments. At the end of the observation period with top watering by means of a hose such action as compacting or aggregation of the soil particles should be measurable, if the treatments have been effective.

—*Harold E. White, Joseph E. Steckel, and Karol J. Kucinski, Departments of Floriculture and Agronomy.*

The Effect of Nutrient Elements and Light on Carnations. No increase in carnation production resulted in a composted greenhouse soil from the addition of peat, sand, manure, or Krilium. Greater

quantities of water and nitrogen were required in direct proportion to the amount of sand added. The soil structure was improved by adding peat moss (3 bushels per 100 square feet) and sand (1 inch per 6 inches of soil), and the levels of nutrients and soluble salts were easily controlled. With additions of manure, the levels of nutrients were more variable, and excess soluble salts were difficult to remove through leaching. The organic matter added with manure decomposed within one year, but peat moss was a relatively stable form for greenouse soils.

—J. W. Mastalerz, Waltham.

Effect of Light on Prolonged Chrysanthemum Bloom and Change of Flowering Habit. To obtain potted chrysanthemums of the desired height and quality during the winter months, seven long days from planting to pinching are required followed by an additional seven long days before short-day treatment. In late spring and summer, planting, pinching and short-day treatments are completed on the same date.

Pinching chrysanthemums with day-length manipulation to eliminate manual pinching was not practical. Ten short days were sufficient to initiate a crown bud and stimulate the growth of auxillary buds, but the pinch occurred at a height of 18 to 20 inches. The manual pinch was made when plants were 3 inches tall. In addition, the labor required to initiate crown buds by covering the plants with black sateen cloth was excessive when compared to manual pinching.

—J. W. Mastalerz and F. J. Campbell, Waltham.

DEPARTMENT OF FOOD TECHNOLOGY

CARL R. FELLERS IN CHARGE

Pasteurization of Fresh Pack Pickles. Heat penetration rates in whole fresh pack pickles in gallon jars have been established. Tests were also conducted to determine the rate of destruction of microorganisms in gallon jars of whole fresh pack pickles during pasteurization. These data together with the heat penetration data obtained confirm preliminary observations, made several years ago, that a pasteurization time of 50 to 55 minutes at 180°F., or pasteurization at a different temperature and time to provide an equivalent sterilizing effect, is indicated for gallon jars of fresh pack pickles.

—W. B. Esselen, E. E. Anderson, and I. J. Pflug.

Sliced Bread and Butter Pickles. Heat penetration data have been obtained for fresh sliced bread-and-butter-type pickles in No. 303, quart, No. 2½ and gallon jars. These data have been employed to derive pasteurization times for this type of pickle in the different jar sizes commonly used.

—W. B. Esselen.

Genuine Dill Pickles. Work on the pasteurization requirements of genuine dill pickles has been continued. Data on heat penetration in gallon jars were obtained. Thermal destruction rates for pectin polygalacturonase in dill pickle brine at temperatures of 135, 140, 145, 150, 155, and 160°F. have been determined. These data are in good agreement with the degree of pasteurization required to destroy this enzyme and prevent softening of dill pickles packed in quart and gallon jars. The results obtained in experimental packs put up during the past season confirmed observations of last year.

—W. B. Esselen and E. E. Anderson.

Thermal Death-Time Methods. Reported under Agricultural Engineering.

—I. J. Pflug and W. B. Esselen.

Frozen Stuffed Chickens. In response to interest that has been shown, work on the bacteriological aspects of frozen stuffed chickens has been started. Tests are underway to determine 1) changes in the total and anaerobic bacteria counts of the dressing of stuffed chickens during frozen storage for one year, 2) the tendency of putrefactive anaerobe spores inoculated into the stuffing to survive during freezing and frozen storage and to grow during thawing, 3) bacteriological changes that occur in the dressing of frozen stuffed poultry during thawing at room temperature, and 4) the effect of Cry-O-Rap and cellophane packaging on the bacteriological conditions in frozen stuffed poultry. The results after six months' storage indicate that putrefactive anaerobe spores inoculated into the dressing were not affected by freezing and frozen storage. During the thawing and holding of frozen stuffed poultry at room temperature, there is a rapid growth of bacteria, which is accompanied by a marked increase of acidity, in the dressing.

—W. B. Esselen and A. S. Levine.

Cooling Packaged Eviscerated Poultry. The possibility of removing the body heat from eviscerated poultry previously packaged in a tight-fitting moisture-proof package such as Cry-O-Rap is being investigated. Cooling rates for broilers, fowl, and roosters, both unwrapped and packaged, in slush ice at 33°F., water at 33°F., and brine at 23°F. have been determined. It took from two to three times as long to cool the packaged poultry to 40°F. as it did unwrapped birds by any one of the cooling methods. However, the cooling rates of packaged poultry in brine at 23°F. were quite comparable to those for unwrapped poultry in slush ice at 33°F. The differences in cooling rates between unwrapped and packaged poultry are attributed to the fact that the packaged poultry cooled from the outside only, whereas the presence of the cooling medium in the body cavity of the unwrapped poultry contributed an additional cooling effect.

—W. B. Esselen and A. S. Levine in cooperation with I. J. Pflug, Department of Agricultural Engineering.

Factors That Influence the Composition of Cranberries. Work on changes in the pectin content of cranberries as they mature on the vine, and during storage, has been continued. Previous observations that variety, bog location, and temperature of storage appear to influence the pectin content of cranberries were reaffirmed during the 1952 season. The significance of these observed differences in pectin content in relation to yield and quality of canned cranberry sauce is being investigated. In all cases, the gel strength of sauces varied with the pectin content of the cranberries from which they were made. It was possible to increase the yield of cranberry sauce, from a given weight of fruit, by as much as ten percent by using cranberries of high pectin content.

—W. B. Esselen, H. Gorfien, and C. R. Fellers in cooperation with The Cranberry Experiment Station, East Wareham.

Nonenzymatic Browning in Strained Foods.

1. *Oxidative Darkening.* Changes in the headspace gas composition of sealed glass tubes containing puréed fruits and vegetables were followed over a limited storage period. Oxygen absorption and production of carbon dioxide were observed to occur in all cases. Rates of change differed with each product studied. Sealed tube studies to determine amounts of ascorbic acid required to inhibit oxidative darkening at different oxygen levels in eight puréed fruits and vegetables have been completed.

2. *Nonoxidative Darkening.* A study of pigment stability in strained carrots and green beans has indicated that little or no change in the concentration and spectral characteristics of the chlorophyllic or carotenoid pigments occurs in storage after processing. In green beans, chlorophyll is nearly totally converted to pheophytin in the preliminary cook. The nonoxidative darkening in storage, therefore, appears to be related to changes in the color of the plant tissue. Studies on these changes are currently in progress.

3. *The Role of Metals.* Sealed tube studies on the effect of iron, copper, and aluminum on the darkening of several purées showed that iron and copper can promote slight discoloration when present in relatively large amounts. Analysis of commercial experimental samples indicated no correlation between darkening and iron content in the absence of cap corrosion. Commercial retort water was found to be of no importance as a possible source of iron contamination. Electrometric measurements showed no evidence of retort water seepage in processing, whereas analysis of retort water samples from a number of commercial plants showed the level of iron to be so low that it would be of no significance if seepage did occur.

4. *The Discoloration of Strained Carrots.* The role of specific chemical constituents, such as sugars, amino acid or nonnitrogenous organic acids, in the discoloration of puréed carrots, is being studied. Both the addition and the selective removal of these compounds as

well as chemical analysis in storage are being used to establish the relative importance of different reactions (such as the Maillard reaction) in carrot browning.

— *G. E. Livingston, W. B. Esselen, I. S. Fagerson, R. J. Vilece, M. P. Baldauf, D. E. Westcott, M. A. Solstad, and H. D. Brody.*

Effect of High Temperature–Short Time Processes on Strained Foods. A number of physical and chemical determinations are being carried out on samples of strained foods sterilized by the Martin Aseptic Canning Process and now held at different storage temperatures. Examination after four months' storage indicated that the primary benefit of this process lies in improved color and thiamine retention. Ascorbic acid and carotene content were not affected. Flavor differences were apparent in some foods but not in others.

—*G. E. Livingston, W. B. Esselen, H. D. Brody, E. Feliciotti, and M. P. Baldauf.*

Fructose–Malic Acid Reaction. The darkening of fructose–malic acid solutions at elevated temperatures can now definitely be attributed to the breakdown of fructose to 5-hydroxymethyl-2-furaldehyde (HMF) and further reaction of this compound to produce the brown colored end products. When the reaction mixture was refluxed in the presence of ethyl acetate, the HMF was extracted as it formed, and darkening did not occur. Similarly, an exhausted malic acid–fructose reaction mixture could be caused to continue to darken upon addition of fructose or HMF, but not malic acid.

Rates of darkening at different concentrations and temperatures have been determined. Several fractions recovered from the end products formed are being characterized.

—*G. E. Livingston and I. S. Fagerson.*

Stabilization of Pigments in Fruit Preserves. The causes for the color changes that take place in stored fruit preserves are being studied. Pigments of cranberries and strawberries have been isolated and purified, and their chemical properties are being studied. Both physical and chemical means of minimizing pigment breakdown are under investigation.

The darkening of preserves and jellies caused by the interaction of colorless precursors, such as sugar, pectin, and acids, are also being considered.

—*G. E. Livingston, C. R. Fellers, R. V. Decareau, M. Steinberg, N. Pandit, and Z. Sabry.*

Low Baume Pickles. Pasteurization studies are being conducted on low Baumé pickles. This type of pickle has a somewhat lower acid and sugar content than the conventional sweet pickles.

Varying concentrations of acetic acid and sucrose were added to cut, freshened salt stock pickles to study their relative inhibitory effect on pickle spoilage organisms and to determine the most desirable

concentration of each from a flavor standpoint. Initial concentrations of 3.5 percent acetic acid and 60 percent sucrose in the brine were required to give the desired cut out values of about 1.4 percent acetic acid and 26 to 29 percent sucrose after equalization.

Processing studies were carried out at 180°F. to determine the heat treatments required to inactivate both microbiological and enzymatic factors. These packs are undergoing storage tests.

Rates of equalization of ingoing sucrose and acetic acid concentrations were determined to be one hour in the processed and nine hours in the unprocessed low Baumé pickles. This knowledge is especially important in processing studies as the high initial levels of acetic acid have a marked lethal effect on enzymatic and microbiological agents.

E. E. Anderson, W. B. Esselen, and M. Cryan.

Role of Organic Acids, Sucrose, and Salt on the Resistance of Acid Food Spoilage Organisms at Room and Elevated Temperatures. In a given food product, increasing amounts of sugars and organic acids, respectively, increase and decrease the heat resistance of food spoilage organisms. However, the exact roles played by these two classes of ingredients, as well as by salt, are unknown.

Investigations are being carried out to determine whether the action of salt and sugar is due to the same effect (i.e., osmotic pressure) or whether other factors are involved. The relative toxicities of the acid molecule and hydrogen ion of acetic and citric acid are being determined.

Microorganisms in this study included *Lactobacillus lycopersici*, *Schizosaccharomyces octosporus*, *Zygosaccharomyces globiformis*, and three pickle spoilage organisms isolated in this laboratory.

—E. E. Anderson, W. B. Esselen, and A. Handleman.

Thickening Agents in Pickle Relish. Various hydrocolloids were incorporated into a commercial pickle relish in an attempt to eliminate the commonly encountered separation of relish and juice. It was anticipated this should also result in a product having a higher drained weight as well as one with greater uniformity of flavor.

Thickeners, in concentration of 0.15 to 4.0 percent, used in this investigation included a seaweed extractive, citrus pectin, sodium carboxymethylcellulose, gum tragacanth, gelatin, waxy maize starch, and modified tapioca starch.

Under existent experimental conditions, a seaweed extractive in concentrations of 0.15 to 0.30 percent and sodium carboxymethylcellulose in concentrations of 0.25 to 0.50 percent proved most desirable from the standpoint of flavor, drained weight, and appearance.

—E. E. Anderson, W. B. Esselen, and A. Blank.

Noncaloric Sweeteners in Canned and Frozen Fruits. As a result of the examination of frozen and canned fruit packs prepared as water packs (common diabetic or dietetic packs) and as packs sweetened with sucrose (regular commercial pack) sodium Sucaryl (sodium

cyclohexysulfamate), and saccharin; the value of the noncaloric sweeteners was very evident. With each fruit these synthetically sweetened packs were judged as being preferable to water packed fruit, which heretofore has been the standard diabetic pack.

Caloric values of the fruits packed with the noncaloric sweeteners were the same as their respective water packs and were less than 50 percent of those values for fruit packed in standard sucrose sirups.

When thickening agents, such as seaweed extractives, pectin, and sodium carboxymethylcellulose, were incorporated into the sirups of saccharin and sodium Sucaryl, improvements in drained weight, viscosity, and "mouth-feel" were observed.

—E. E. Anderson and W. B. Esselen.

Pre-peeled Potatoes and Other Vegetables. Increasing the acidity of sulfite dipping solutions (used to prevent the discoloration of peeled, raw, white potatoes) to a pH of about 2.0 by adding hydrochloric acid or one percent citric acid increased the efficiency of the dipping solution markedly in extending the storage life of the treated potatoes.

The necessity of holding the treated potatoes at temperatures of 40°F. or below to prevent both enzymatic and microbiological deterioration was reaffirmed.

Preliminary work has indicated the effectiveness of sulphite dips in preventing the discoloration of other peeled vegetables, such as turnips and parsnips. Local producers have expressed a desire to market these vegetables at retail level in a raw, diced form.

—E. E. Anderson and W. B. Esselen.

Vegetable Blanching Studies. Off-flavor and color in home frozen vegetables indicate that inadequate blanching may be the cause. Peas, spinach, broccoli and two varieties of snap beans were studied to determine the length of blanch necessary to inactivate enzymes to prevent quality loss during storage. Taste and chemical tests indicate that longer blanching times than those now in common use are required. Further studies will be conducted on additional vegetables to determine adequate blanching times. Varietal characteristics for freezing were noted during the study.

— K. M. Hayes and W. B. Esselen.

Food Freezer Plan Investigations. Investigations on the current food freezer plans have been made. Various plans in Central and Western Massachusetts were studied to determine the amount and type of food furnished, the nutritional adequacy for the period covered; the size, type and cost of the freezer; cost of operation; and finance charges. Frozen food prices of the plan were compared with retail store prices. The results showed that package size may not be an economical size for some families; that the supplied amounts of juices, fish, meat, and poultry are nutritionally adequate, but the amounts of fruits and vegetables are low. The investigation showed that little or no saving resulted when the frozen food was purchased under a plan when compared with retail store prices. The food freezer plan was found to offer more in convenience than in economy.

— K. M. Hayes.

Quality of Processed Foods. This project, which was initiated in 1951 (see Annual Report 1951 to 1952), has been continued. During the past year, evaluations of the quality of frozen and canned shrimp, canned orange juice, grapefruit juice, and orange and grapefruit blend, tomato catsup, canned corn, canned pineapple, and canned applesauce have been made.

Canned and Frozen Shrimp. Four types of frozen shrimp were examined, cooked, peeled, ready-cooked, French-fried; breaded, ready-to-fry, and headless frozen in shell. A total of five brands of cooked and peeled shrimp were examined, of which two brands were classified as Grade A, and three as Grade B. Of the three brands of frozen, ready cooked, French-fried shrimp, one was Grade A, one Grade B, and one Grade D. Fifteen of the nineteen brands of frozen, breaded, ready-to-fry shrimp were found to be Grade A, two Grade B and two Grade D. Ten brands of canned wet pack shrimp were examined, of which four brands were Grade A, and six brands Grade B. The percentage of actual shrimp meat content for each of the types was determined yielding the following average values: frozen cooked, French-fried 60.0 percent; headless, frozen in shell, 79.3 percent; breaded, ready-to-fry, 57.5 percent; canned wet pack, 63.0 percent.

Canned Orange Juice. Thirty-one of the most popular brands of this product were examined. Fifteen were found to be Grade A according to the U.S. Department of Agriculture standards. Sixteen lots were found to be Grade C (there is no Grade B classification for canned citrus juices). Reduced ascorbic acid content ranged from 18.6 to 57.6 mg. per 100 ml. of juice with an average of 39.3 mg. per 100 ml.

Canned Grapefruit Juice. Thirty-nine brands of this product were examined of which thirty-three were found to be Grade A, five were Grade C, and one Grade D. Reduced ascorbic acid content ranged from 14.2 to 40.1 mg. per 100 ml. of juice with an average of 30.1 mg. per 100 ml.

Canned Orange and Grapefruit Blend. Thirty brands were examined. Eighteen brands were Grade A, eleven Grade C, and one Grade D. Reduced ascorbic acid content ranged from 19.0 to 45.6 mg. per 100 ml. of juice with an average of 34.2 mg. per 100 ml.

Tomato Catsup. Thirty-seven brands of tomato catsup were evaluated for quality by U.S. Department of Agriculture standards. Twenty-two brands were Grade A; thirteen brands were Grade C (there is no Grade B classification for catsup); and two brands were D Grade.

Canned Corn. Three styles of canned corn were examined according to U.S. Department of Agriculture standards. Of twenty-six brands of cream-style corn examined, eight brands were Grade A, fourteen were Grade B, and four were Grade C. Of seventeen brands of whole kernel corn, brine pack, eleven brands were Grade A, six were Grade B, and one was Grade C. Fourteen brands of whole kernel vacuum pack corn were examined. Ten were Grade A, three were Grade B, and one Grade C.

Canned Pineapple. Fifty-seven brands of canned pineapple were examined according to U.S. Department of Agriculture standards

of quality. Of the twenty brands of sliced pineapple, 13 were Grade A, and seven were Grade B. Of sixteen brands of "chunk" style pineapple, nine were Grade A, and seven were Grade B. Twenty-one brands of crushed pineapple were examined. Fourteen were found Grade A, five were Grade B, and two were Grade C.

Canned Applesauce. Thirty brands of this product were examined according to U.S. Department of Agriculture standards. Only one brand was classified as Grade D. Ten brands were Grade C (there is no Grade B classification for this product); the remainder, Grade A.

—I. S. Fagerson, E. E. Anderson, C. R. Fellers, and K. M. Hayes.

Equilibrium Relative Humidity Studies. This project has been continued from last year (see Annual Report 1952). Studies on soluble coffee powder and a gelatin dessert powder have shown that the semimicro method developed here shows very good correlation with macro methods in current use. A principal advantage of the former method is a marked reduction in time required to obtain equilibrium relative humidity data. To determine general applicability the project is being continued with a variety of other food materials.

—I. S. Fagerson and A. S. Levine.

Utilization of Chelating Agents in Foods. Toxicological studies made here on acute, subacute, and chronic feeding of ethylenediaminetetraacetic acid to white rats have shown a low order of toxicity. No noticeable toxic effects have been noted on long-term chronic feeding experiments with white rats. Allergic responses on guinea pigs have been nil. The LD_{50} for rats has been found to be between 2.0 and 2.2 grams per kilogram of body weight.

—C. R. Fellers, L. R. Parkinson, I. S. Fagerson, and M. Chan.

Effect of Monosodium Glutamate on Processed Foods. Samples of canned sardines and three types of canned salmon, chum, pink and Chinook, with added monosodium glutamate (MSG) and hydrolyzed vegetable protein were evaluated for flavor by taste panel techniques. In sardines no significant differences were observed between controls and those with MSG added in amounts up to 0.3 percent by weight of salmon. In chum salmon there was no significant preference exhibited for these samples with added MSG or hydrolyzed vegetable protein over control samples. For both pink and chinook salmon there was preference at the 5 percent significance level for samples with added hydrolyzed vegetable protein (0.75 percent, over controls, but no significant preference for samples with added MSG (0.15 percent).

—I. S. Fagerson, C. R. Fellers, and A. Blank.

Freezing Shell Eggs. No feasible method of freezing shell eggs to maintain the original physical and cooking qualities was found. Vacuum dehydration allowed shell eggs to be frozen without shell breakage.

In frozen whole-egg or yolk, papain effectively prevented gelation. However, the impossibility of controlling the activity of the enzyme during freezing storage and defrosting makes the use of papain impracticable.

In shell eggs, the following factors had no effect upon gelation of yolks: period of storage, incubation, partial dehydration, freezing and frozen storage in oxygen atmosphere.

The degree of gelation of yolks of shell eggs was lower when the eggs were frozen in CO_2-acetone mixture and thawed by immersion in water. Shell eggs subjected to ultrasonic vibrations before freezing showed a high degree of gelation.

The content of free phosphatides of frozen yolk was found higher than that of unfrozen yolk. The solubility properties of the lecithovitellin of yolk were affected by freezing. Egg yolk fat had the same melting point before and after freezing.

It has been found that the content of free phosphatides in egg yolk is increased by the freezing process. However, it did not increase further after a frozen storage period of 30 days. Egg fat had the same melting point before and after freezing. The solubility of the lecithoprotein of yolk was markedly affected by freezing.

—A. Lopez, W. Powrie, and C. R. Fellers.

Further Toxicological Studies on Ethylenediaminetetraacetic Acid. Toxicity studies were conducted on the effect of ethylenediamine tetraacetic acid (Sequestrene) at two levels, 0.5 percent and 1.0 percent of the diet, on 50 Wistar albino rats subsisting on a marginal mineral, but otherwise adequate, purified diet. Two complexed forms of the acid were used—disodium Sequestrene and monocalcium disodium Sequestrene. To date, after six months of oral feeding, results indicated no observable toxicity of the chemicals to the test animals. The 0.5 percent level of both the disodium Sequestrene and the Calcium sodium Sequestrene compared well with the control group. A mild side reaction was found at the 1.0 percent level in both salts with slight diarrhea and very slight decrease in growth. Metabolism studies and further toxicological evaluations are in progress. Sequestrene is almost completely eliminated from the body through the feces.

C. R. Fellers, M. S .Chan, and L. R. Parkinson.

Rodenticide Investigations. The anticoagulant rodenticides are now used most extensively in rodent control operations in which time is not a factor, and effective control is desired. Two new anticoagulant rodenticides have been approved for use. They are Tomorin and Pyval. Both are just as effective as Warfarin, and in addition Pyval seems to have some anti-mold and insecticidal properties. Water soluble forms of Warfarin and Pyval are available, and when properly used, good control can be obtained. The anticoagulant rodenticides can all be tested by chemical or colorimetric methods. Sodium-fluoroacetate or Compound 1080 is still the most effective rodenticide ever developed but its extreme toxicity to all animals and persons makes it too hazardous; it should be used only by licensed operators. Fortified Red Squill

of good quality is still available and should be used when quick results with a high degree of safety are necessary.

—L. R. Parkinson, C. R. Fellers, and F. A. Vlach.

Chinchilla Research. The reluctance on the part of most female chinchillas to mate successfully with any male selected by the owner has created a problem of keeping many surplus males. These males may or may not be of good breeding types. Therefore, a method of breeding any male with any female would be a distinct advantage to the fur industry and to the chinchilla ranchers in particular. Studies are now underway to determine certain pertinent facts about the physiology of reproduction of the female chinchilla. An electrical apparatus to obtain semen artificially from the males has been developed, and it is now possible to obtain viable semen from male chinchillas. Female chinchillas have been inseminated. However, refinements in the insemination technique need to be made. Tests involving different media, storage periods, and temperatures for the sperm are in progress.

—L. R. Parkinson in cooperation with R. W. Bullard and J. G. Snedecor of the Department of Zoology, and C. S. Roys of the Department of Electrical Engineering.

DEPARTMENT OF HOME ECONOMICS NUTRITION

ANNE W. WERTZ IN CHARGE

The Effect of Socio-Economic Factors on the Adequacy of the Mother's Diet. As reported previously (Mass. Agr. Exp. Sta. Bul. 469, 1952) it was found that the diets of a high percentage of the women cooperating on the study of the Nutritional Status of Pregnant Women did not meet the Recommended Allowances of the National Research Council in certain nutrients.

The data concerning the total income of the family, the amount of money spent for food, size of family, and the education and occupation of the wage earner were examined in order to determine whether any of these factors influenced the adequacy of the mother's diet. In the group studied, the amount of money spent for food was not dependent on the total income. The adequacy of the diet was not dependent on the amount of money spent for food. An increase in family size caused a decrease in the amount of money spent per food expenditure unit, but did not affect dietary quality as reflected in the mother's diet, indicating that the larger family spent their food budget more wisely. A definite relationship existed between the adequacy of the mother's diet and social level as evidenced by the husband's occupation. In a comparison of the adequacy of the diet with the mother's education, a trend toward a more adequate diet was indicated in mothers with more education.

—G. C. Murphy and A. W. Wertz.

Strain Differences in Nicotinic Acid Metabolism. The differences in nicotinic acid metabolism in two strains of rats (previously reported in Mass. Agr. Exp. Sta. Bul. 467, p. 70, 1953) have been investigated further. The following differences are evident: 1) Rats of Strain I excrete 1.69 to 4.33 times more total niacin metabolites than rats of Strain II in comparative periods of pregnancy; 2) Rats of Strain I excrete a consistently higher proportion of the total quantity of niacin metabolites as N'methylnicotinamide. Nonpregnant Strain I rats excrete 62 to 72 percent of the total as N'methylnicotinamide; nonpregnant Strain II rats, 31 to 45 percent; 3) in Strain I, the increases of the acid hydrolyzable fractions of niacin and N'methylnicotinamide are very nearly proportional as pregnancy progresses, whereas the N'methylnicotinamide in Strain II increases more rapidly than the acid hydrolyzable fractions.

—L. P. Guild, M. E. Lojkin, and A. W. Wertz.

Complications of Pregnancy in Relation to Adequacy of Mother's Diet. In the group of 81 subjects studied, it was not possible to demonstrate any correlation between the abnormalities of the babies and the complications during pregnancy and parturition, with the adequacy of the mother's diet.

—A. W. Wertz, M. E. Lojkin, G. C. Murphy, and L. P. Guild.

Amino Acid Metabolism in Pregnancy. A study of the amino acid metabolism of pregnant women has been started this year. Urinary amino acid excretions will be determined on usual diets and on diets supplemented with some of the amino acids. Certain amino acid and vitamin interrelationships are being studied.

—A. W. Wertz, M. E. Lojkin, G. C. Murphy, and L. P. Guild.

The Nutritional Status of Pregnant Women. The purpose of this investigation was the correlation of dietary surveys, biochemical studies, and medical examinations as measures of nutritional status of pregnant women. The findings of the dietary, chemical, and clinical determinations have been reported previously (Mass. Agr. Exp. Sta. Bul. 469, 1952; Bul. 467, p. 67, 1953). Results of statistical calculations of the data established the existence of the following correlations. Among the pathologic conditions of the skin, the incidence of acne was associated with blood levels of vitamin A at a one percent level of significance and the incidence of nasolabial seborrhea with blood ascorbic acid and dietary vitamins A and C at the 10 percent level. A pathologic condition of the tongue (reddened and magenta) was correlated with blood hemoglobin (one percent) and dietary ascorbic acid (10 percent). Blood hemoglobin levels were associated with dietary iron (5 percent and protein (5 percent), and the blood vitamins A and C with dietary vitamins A (5 percent) and C (one percent), respectively.

The number of significant correlations was small. Many of the pathologic signs observed were not correlated with blood values or dietary intake of essential nutrients.

It has been observed in the investigation that subjects with adequate or high nutritional status frequently showed lower associations between dietary, blood, and medical findings than subjects of low nutritional status. The trend could not be proved to be statistically significant.

—*M. E. Lojkin, A. W. Wertz, G. C. Murphy, and L. P. Guild, in cooperation with Eugene M. Holden, M. D., of Amherst.*

DEPARTMENT OF OLERICULTURE

GRANT B. SNYDER IN CHARGE

Asparagus Investigations. A breeding program to develop a better and higher yielding variety of asparagus has been under way at the Waltham Field Station for 25 years.

The results of this work have culminated in a new variety, which has been named *Waltham Washington*. This new variety has been selected three generations from the Washington variety. The three best lines of nineteen, which were not only high-yielding but very similar in genetic make-up, were put together to make this new variety.

Individual plant performance records were taken. The ten best males with a yield of 1.5 pounds per plant per year and thirty females that had an average production of one pound per plant per year were selected. These yields were in comparison to 0.65 pound per plant for the best commercial lines.

On the basis of yields per acre, the comparisons are more favorable to *Waltham Washington* because fewer plants have been killed by cold or disease. Only 2.7 percent of the plants have been lost from the three selected lines, whereas in the two commercial varieties an average of 19 percent of the plants have been lost.

There is no significance in the size, grade, or season of *Waltham Washington* compared with the best commercial variety.

Stock seed of this new variety was produced by allowing the 40 selected plants to grow and produce seed, and the remainder of the plants were cut for the regular six-week period. At the end of this period all the blossoms on the selected plants had set seed; therefore, there was no possibility of contamination.

Stock seed has already been released to seed growers, but much seed will not be available until 1956.

—*Robert E. Young.*

Breeding and Cultural Problems of Greenhouse Vegetable Crops.

Tomatoes. A study is being made of the effect of the time of planting the spring crop of greenhouse tomatoes on yields, grade, and economic returns. Plants were set in the greenhouse February 1 and 15, and March 1 and 15, 1952. The results obtained this year did not differ much from those previously reported.

Because of differences in the February weather and prices received, the gross receipts less the heating costs were about the same for both the February 1 and 15 plantings. The cost of heat for the first planting was found to be only 12.7 percent of the gross receipts. As a result of the information obtained through this project, it is recommended that greenhouse tomato growers plan to plant the crop in mid-February.

A fall crop of greenhouse tomatoes was grown to determine whether topping the plants October 1 would hasten maturity and affect the size of fruit and total yields of the crop. This topping had no significant effect on either size or grade but did hasten maturity slightly. The yields to December 1 were slightly in favor of the topped plants. The results of this experiment have shown that neither blossom removal nor removal of the top hastens maturity or increases production significantly.

Radishes. Breeding work with greenhouse radishes was continued, using selections grown last year in comparison with several commercial varieties. The best massed selection was more uniform in size, shape, and color, and produced 23 percent greater marketable yield and 34 percent more No. 1 radishes than the best commercial variety.

During the year it was found that the radish roots could be sampled to determine pithiness and still obtain a seed crop. Using this method, selections were made that were not pithy even though large in size. When uniform for this character, the strain will be ready for release.

—*Robert E. Young.*

Vegetable Breeding For Improvement of Quality and Adaptability.

Lettuce. Trials of a new selection of New York type lettuce continue to look good for an early transplant lettuce. This is a crisp type of lettuce which may be too crisp to withstand shipment and market handling, but that can only be determined by growers' trials. An attempt was made to produce a crop of seed, but aster yellows destroyed most of the plants.

Work has also been under way to develop a uniform strain of Great Lakes lettuce better adapted to local conditions. During last year's trials this strain produced a larger percentage of marketable heads than did commercial strains in the trial. It is uniform in size, shape, and maturity. The seed crop of this season was also very much reduced by aster yellows.

Cabbage. The work of breeding a small-headed cabbage borne on a small upright plant adapted to this area has progressed. A spring crop of 30 different kinds was grown. Crosses were made to incorporate clubroot and yellows resistance and to improve fertility of the best lines. Thirty-two strains, varieties, and hybrids were grown as a fall crop. The most important lack in the best selections is sufficient fertility or seed set to make a seed crop commercially possible. Efforts are being made to find better methods of determining seed setting characteristics.

—*Robert E. Young.*

Seed Improvement.

Trellis Tomatoes. The work of breeding a trellis tomato that does not crack as much as *Trellis No.* 22 has progressed to the point where samples of the new strain were put out for trial on growers' farms. Selection for uniformity of maturity remains to be made. From data obtained there appears to be a linkage between crack resistance and late maturity; to obtain an early tomato it is necessary to take less crack resistance.

In a year such as 1952 when there were long periods of hot, dry weather, 48 percent of the fruit of *Trellis No.* 22 had a crack of some kind, whereas the late crack-resistant strain had only 18 percent, and the early types had 25 to 30 percent.

The results of the work to develop a better determinate variety for local use is a new variety that has been named *Waltham Beauty*, and it has been given out for trial to growers of this type tomato. This new variety produced more early fruit than *Red Cloud*, one of the best commercial types. It had a greater total yield and less cracking along with firmer fruit and better half-ripe color.

Hormones. The use of hormone sprays to set fruit on the first cluster of trellis tomatoes again proved to be very advantageous. The production of early fruit was increased 50 percent with no significant differences in total yield.

The value of the hormone sprays in speeding up maturity seems to be worthwhile even in years when the weather is satisfactory for natural set.

Type of Trellis. During 1952, a year of extremes in weather during the cropping season, tomatoes grown on the "A" type trellis produced more No. 1 fruit, and the percentage of cracking was reduced. It is the first time in three seasons that this has happened. The yield of early fruit on the "A" trellis is comparable to the standard single trellis, but the yields in the last half of the season are greatly reduced.

Miscellaneous. Breeding work with butternut squash, greenhouse tomatoes, and carrots is being conducted. Although progress has been made, it is not sufficient to justify a separate report.

— *Robert E. Young.*

Breeding Sweet Corn, Peppers, and Field Tomatoes for Massachusetts.

Sweet Corn. Improved *Gold Mine* sweet corn continues to show a two-day advantage in earlier maturity than the regular *Gold Mine*. This variety has repeatedly matured corn two to four days earlier than any of the commercial early varieties included in the trials. Experimental hybrid C13-1 x 21547-1-1 is in season with *Marcross* and provides an excellent variety for this season. Seed of this hybrid has been disseminated widely for trial during 1953.

The search for extra early *Golden Cross Bantam* types is being continued, and some inbreds have been developed that should ultimately provide a variety of this type.

There was some evidence that certain plants of inbred 21547-1-2 have the ability to restore fertility when crossed on to cytoplasmic male sterile inbreds.

Tomatoes. Two F_1 hybrids involving *Red Cloud* as one parent were once again the highest yielders of early, first quality fruit. One of these was particularly free from blemishes and quite firm, with a desirable globe shape. Particular attention is being paid toward introducing firmness and the crack-proof character into these hybrids. Seed of the two most desirable hybrids found thus far are being increased so that they can be put out for wide trial.

Peppers. Eight selections were made from the most desirable plants in the 1952 trials. These plants were quite productive of early, blocky, thick-walled fruits. Twenty-one lots of peppers obtained from the U.S. Bureau of Plant Introduction all proved to be of the *Cayenne* or hot-type peppers.

—*W. H. Lachman.*

Weed Control in Vegetable Crops. The search for a chemical weed killer for onions continues as a major part of this project. Pre-emergence applications of Chloro IPC in replicated plots of onions grown from sets revealed that 6 to 8 pounds of this chemical gave commercial control of all annual weeds for eight weeks with no reduction in yield of onion bulbs. This treatment is the most promising of many tests made during the last eight years.

Several chemicals were found to be effective in controlling weeds without crop damage in fields of sweet corn. Among the best of these were 15 to 20 pounds of Sodium Pentachlorophenate, 6 pounds of DNOSBP in Premerge, one quarter to one half pound of CMU weed killer and 1.5 pounds of 2,4-D and MCP in delayed pre-emergence applications.

CMU weed killer was the most promising material as a herbicide for established asparagus beds. Two pounds of CMU applied just after discing in the early spring prevented all weed growth for nine weeks without damage to the asparagus. It is significant that this treatment killed out a heavy sod of nutgrass (*Cyperus esculentus*).

Successive applications of Chloro IPC to replicated plots of spinach showed that two pounds of this material provided good control of annual weeds, but increasing crop damage resulted for each day that the application was delayed after planting the spinach.

—*W. H. Lachman.*

The Culture and Nutrition of Vegetables. Onion blast, a physiological disease, and onion mildew, a fungus disease, limit the culture of direct seeded onions in the Connecticut Valley. Sprays of Dithane on replicated plots of onions during 1952 resulted in somewhat higher yields of bulbs, but treated plants did not remain greener nor grow perceptibly longer than untreated controls.

Eighty-two F_1 hybrids and three standard varieties of onions were grown in the greenhouse and transplanted out-of-doors late in April. Each of the lots were replicated six times to allow for soil variation and other sources of experimental error. The yield of bulbs over two inches in diameter varied from 435 to 1020 50-pound bags per acre. It is rather significant that nine of the hybrids outyielded the highest

yielding of the standard varieties. This increase in yield of the F_1 hybrids is clearly seen to be the result of larger-sized bulbs.

Preliminary experiments indicate that the production of seed stalks in fields of onions grown from sets may be reduced significantly or even prevented by storage of the sets for 9 to 16 weeks at 30°C. before planting.

—W. H. Lachman.

The Effect of Simulated Hail Damage to Selected Vegetable Crops. Hail causes varying degrees of damage to crops depending on severity and the period of growth at which such damage occurs. Studies in this project endeavour to establish a factor for degree of damage at a given stage of growth to the probable percentage of reduction in yield of tubers for potatoes, fruits for tomatoes, or pods for beans.

As part of the project a machine has been developed to simulate hail conditions including controlled wind, water, and ice. Damage to plants on this basis are identical to that of actual hail storms.

Preliminary studies indicate that there is a correlation of stage of growth at which foliar or stalk damage occurs to yield of tuber in fruits or pods.

—Grant B. Snyder.

DEPARTMENT OF POMOLOGY

A. P. FRENCH IN CHARGE

Influence of Chemical Treatments on Flowering and Fruiting of Fruit Trees.

Chemical Fruit Thinning. Major emphasis in 1952 was placed upon comparative testing of naphthaleneacetic acid or its sodium salt (NAA) in spray or dust form with naphthaleneacetamide (NA Amide) on apples, pears, and peaches after petal-fall. In addition, some attempts were made to determine the influence of NAA materials on the thinning of apple trees of varying nitrogen levels.

NA Amide was found to be a milder thinning material on apples than NAA formulations when both were applied 10 days or more after petal-fall. This was usually true even when NA Amide was applied at twice the concentration of NAA. NA Amide caused no visible foliage injury to any of the apple varieties tested and appears to be a very promising chemical thinning material for apples providing it is capable of reducing the set sufficiently on heavy setting varieties.

Attempts to thin Seckel pears about two weeks after petal-fall with NAA and NA Amide were a failure. Neither material applied four weeks after bloom thinned Summercrest peaches appreciably, although NAA materials have satisfactorily thinned other peach varieties in some other years.

Where adequate thinning of apples was accomplished on apples with NAA or NA Amide in 1952, the trees bloomed sufficiently in 1953 to produce a moderate to full crop.

It appears that with some varieties of apples the degree of thinning obtained with NAA materials can be correlated with the nitrogen level of the trees. McIntosh trees at a low level of nitrogen were thinned to a greater degree than similar trees at a higher level of nitrogen. With Golden Delicious, however, differences in nitrogen level did not appear to influence the degree of thinning obtained. The role of other elements has not been studied.

Pre-harvest Drop Control. In 1952 a comparative test was made between 2,4,5-trichlorophenoxyacetic acid (2,4,5-TA) and 2,4,5-trichlorophenoxypropionic acid (2,4,5-TP) on McIntosh. Both of these materials are capable of reducing the rate of fruit drop for three weeks or longer, if applied a few days ahead of the time when natural abscission commences. For about three weeks after the application of these materials, 2,4,5-TA appeared to be slightly inferior to 2,4,5-TP for drop control. After this period of time, however, 2,4,5-TA was somewhat superior to 2,4,5-TP.

—*F. W. Southwick and W. D. Weeks.*

The Influence of Orchard and Post-Harvest Treatments on the Metabolism of Tree Fruits. Attempts were made to determine the influence of 2,4,5-trichlorophenoxypropionic acid (2,4,5-TP), a pre-harvest drop control material, and maleic hydrazide (MH), a growth inhibitor, on the rate of respiration, softening, and color development of apples grown on trees of varying nitrogen levels. Results indicate that the ripening response obtained after spray treatments with 2,4,5-TP or MH may be markedly influenced by the nutritional status of the tree. When 2,4,5-TP is applied to Golden Delicious and McIntosh trees high in nitrogen, it hastened the rate of respiration, color development, and softening of the fruit to a greater degree than similar treatments on trees at a lower nitrogen level. Fruits from high-nitrogen trees treated with 2,4,5-TP were much more subject to internal breakdown and splitting in storage than fruits from low-nitrogen trees similarly treated. MH, applied at 250 to 500 ppm to McIntosh about five weeks ahead of harvest, depressed the rate of respiration and softening. The degree of depression was apparently influenced slightly by the nitrogen level of the trees, also. MH depressed the rate of respiration of fruits from low-nitrogen trees to a greater degree than it did fruits from trees of a higher nitrogen status.

Comparisons of apples from trees treated at the same time and with the same concentrations of the pre-harvest drop materials 2,4,5-TP and 2,4,5-trichlorophenoxyacetic acid (2,4,5-TA) indicate that 2,4,5-TA hastens ripening less than 2,4,5-TP.

Storage studies were conducted on Cortland and Rhode Island Greening to determine the influence of varying temperatures on storage scald development. Composite samples of each variety were held for varying lengths and periods of time at 40° and 32°F. With both varieties it was possible to reduce scald by continuous storage at 40°F. as compared to similar treatment at 32°F. However, storage at 40°F. at one- to four-week periods during the season (and the rest of the

time at 32°F.) did not necessarily reduce scald compared to fruit stored continually at 32°F. Cortland held for the first two to four weeks of their storage period at 40°F. developed less scald than similar fruits held at 40°F. for identical periods of time later in their storage period. However, Rhode Island Greening reacted in opposite fashion and developed less scald when held at 40°F. for the last two to four weeks of their storage period.

—F. W. Southwick.

Nature of Winter Hardiness in the Raspberry. Limited biochemical data indicate that the migration velocities, refractive indices, and relative viscosities, at zero time, of suspensions of homogenized tissue of hardy and tender varieties are essentially identical; that the hardy variety contained the greater amount of replaceable hydrogen and had a greater optical density; that the ultraviolet absorption curves in 79 percent sulfuric acid are different in the region of 245 millimicrons.

When the mechanism of cold injury and resistance is understood, it should be possible to alter cultural practices to influence this mechanism. Elimination of even half the winter injury would result in a 10 to 15 percent increase in crop over a period of years.

—J. S. Bailey, F. W. Southwick, and Emmett Bennett.

Study of Bud Sports of the McIntosh Apple. The influence of nitrogen fertilization on the development of red fruit color for the different sports was studied during the past season. Half of the trees were fertilized with two pounds of nitrate of soda per tree and half with four pounds. The trees were in their eleventh growing season. Leaf samples for nitrogen determinations were taken in August, and fruit samples for color were taken just prior to harvest.

Although there was considerable variation in the leaf nitrogen and amount of red color found in both the low and high nitrogen-treated trees, there were differences between sports and nitrogen treatments in the development of red color on the fruit. Red color was depressed by high nitrogen fertilization, but the Rogers strain had significantly less reduction in color than any of the other strains.

—W. D. Weeks, and F. W. Southwick.

The Nutrition of Apple Trees. The orchard in which this study is being conducted had a very light bloom in 1952. A study of the yield records for 1951 and 1952 revealed that the light bloom and crop of 1952 was not associated with the nutritional levels established by the different fertilizer treatments but was associated with the size of the 1951 crop. The size of the crop has considerable influence on the chemical composition of apple foliage. In years of light crops, nitrogen and phosphorus decreased, whereas potassium, calcium, and magnesium increased. High rates of inorganic nitrogen alone continue to cause an unfavorable balance with potassium even in light crop years. The potassium content of leaves from trees receiving high rates of ammonium nitrate was below the level considered critical for potassium deficiency.

—W. D. Weeks, F. W. Southwick, Mack Drake, and J. E. Steckel in cooperation with the Departments of Chemistry and Agronomy.

Study of Tree Characters of Fruit Varieties. Forty varieties of apple were propagated to establish vegetative characters for positive identification and elimination of misnamed trees in commercial nurseries.

—W. D. Weeks, A. P. French, and O. C. Roberts.

The Influence of Various Clonal Stocks on Apple Varieties. This project was discontinued because of faulty design of the experimental blocks and because the main experimental block is to be used for campus development in the near future.

Malling stocks found to have no value for commercial orchards in Massachusetts are VIII, IX, III, IV, V, X, XII, and XV. Stocks that show considerable promise for semidwarf trees are I, II, and VII. Malling XIII appears to be adapted for wet soils, and Malling XVI shows considerable merit for producing vigorous high-yielding trees. Naturally weak-growing varieties do very poorly on semidwarf stocks, such as I and V.

—W. D. Weeks and F. W. Southwick.

Studies of Varieties of Fruits. A series of articles published in *Fruit Notes* during the year gave information on 75 new varieties of apple, pear, peach, blueberry, strawberry, and grape.

Mass. C-31, a promising new apple seedling, was introduced and named *Puritan*. Scions have been offered and distributed to interested growers and experiment stations.

—W. D. Weeks and Staff

Nutrition of the Highbush Blueberry, Especially in Relation to Soil Reaction. The work on the correcting of magnesium deficiency in cultivated blueberries was brought to a conclusion and will be published in a future volume of the *Proceedings of the American Society for Horticultural Science*. It was concluded that magnesium can be supplied to cultivated blueberries by a soil application of either epsom salts or dolomitic limestone. Where the soil pH is about 4, one and a half tons of agricultural lime can be applied without causing lime chlorosis, but an application of one ton per acre appeared to be sufficient to raise the leaf magnesium above the deficiency level. Twenty-five pounds of MgO as epsom salts or 200 pounds as dolomitic limestone per acre were required to reduce the magnesium deficiency symptoms to a minimum. The leaf magnesium level at which deficiency occurs has not been definitely established but appears to be somewhere between 0.10 and 0.20 percent Mg.

—J. S. Bailey and Mack Drake.

Blueberry Culture. Waste hops appear to be a good mulch for blueberries. Although the mulch packs considerably when first applied, it will not keep quack grass under control. Two selections were discarded during the year, BM-22 and US-1. Two others, 18-116 and R-86, have been added to the planting at East Wareham. Freezing trials were started to test the cold resistance of new varieties and selections of blueberries.

—J. S. Bailey.

Improvement of the Wild Lowbush Blueberry.

Brush Control. Lowbush blueberries appear to have considerable resistance to the new herbicide CMU. After an application as high as 60 pounds per acre in July, some blueberry plants were still alive in September. Since it appeared that 20 pounds per acre or less might be effective in eliminating such persistent weed pests as sweet fern and brakes, applications of 5, 10, 15, and 20 pounds per acre were made in September. There was little evidence of the CMU becoming effective during the fall. The 5-, 10-, 15-, and 20-pound applications were repeated in April 1953.

—*J. S. Bailey.*

Chemical Control of Weeds in Fruit Plantings.

Strawberries. During the summer, sodium 2,4-dichlorophenoxy ethyl sulfate (C.H.#1) has generally given satisfactory control of weeds. No injury to the strawberries has resulted except on very light sandy soils in the Falmouth area. On such light soils the application should not exceed two pounds per acre and should be on an experimental basis only. On medium to heavy soils three pounds per acre appears safe.

Sodium 2,4-dichlorophenoxyl ethyl benzoate (Sesin) used on a very light soil gave unsatisfactory weed control at three or four pounds per acre. At five or six pounds, weed control was good. This material looks promising.

Dinitro ortho secondary butyl phenol applied at one pound per acre in November gave good control of chickweed where the infestation was not too heavy and the chickweed was small.

Chloro IPC applied at two pounds per acre in November gave good control of chickweed. Used in mid-March it retarded but did not kill all chickweed.

Cultivated Blueberries. Blueberries appear to tolerate up to 12 pounds of CMU per acre. Two or four pounds per acre gave poor weed control; eight pounds per acre gave fair weed control; and twelve pounds per acre gave excellent weed control except in heavy stands of quack grass (*Agropyron repens*).

Chloro IPC applied April 1 at 24 pounds per acre gave excellent control of sheep sorrel (*Rumex acetosella*) and annual grasses. At 16 pounds per acre or less, control was unsatisfactory.

—*J. S. Bailey.*

DEPARTMENT OF POULTRY HUSBANDRY

FRED P. JEFFREY IN CHARGE

Inbreeding White Plymouth Rocks for Various Egg Quality Characters. Fourteen inbred matings are being carried on with White Plymouth Rocks. Some progeny being produced in 1953 are 59 percent inbred. A marked family difference has been noted in the ability of AA quality eggs to withstand albumen deterioration under storage conditions of the ordinary egg room. Eggs from one family are still of AA albumen quality after 28 days of holding at 50° to 70°F. This observation applies only to eggs laid shortly after the onset of egg production because observations made in April and May are not comparable to those made early in the laying year.

—F. P. Jeffrey and J. R. Smyth, Jr.

Broody Instinct Completely Eliminated in a Line of Rhode Island Reds. Evidence previously reported on this flock indicates that two dominant complementary genes are responsible for the broody instinct and that these genes are autosomal.

Selective pedigree breeding was carried on for many years without completely eliminating the broody trait. When, however, all females were tested by the use of prolactin it was possible to select breeders that carried neither broody gene, and the instinct was eliminated.

The four generations hatched from 1944 to 1947 averaged 2.6 percent broody in the pullet year with a mean egg production of 208. The four generations hatched from 1948 to 1951 with complete annual records were entirely free of broodiness, but the mean egg production was 194. The last generation with complete annual record averaged 201 eggs. At present, selection pressure is being applied to improve both egg production and viability.

—F. A. Hays.

Artificial Light Stimulates Old Birds to Higher Fertility in Winter. Various tests using all-night lights and morning lights turned on at 4 A.M. show a stimulating effect on fertility in pedigree pen matings. Compared with controls, males 24 months of age or older showed a significant improvement in fertility from both types of light exposure. Old hens appear also to respond to light exposure with more eggs and a higher degree of fertility. Cockerel and pullet breeders gave little response to artificial light.

—F. A. Hays.

Selective Breeding Does Improve Hatchability. Population studies made by several workers indicate that hatchability has a low degree of heritability. Nevertheless, a research project carried on here with Rhode Island Reds has produced a high hatching line and a low hatching line. These lines are now in the eighth generation, and there has been a significant difference between the lines in all generations. The eighth generation tested in the Spring of 1953 gave a mean hatchability of 94 percent for the high line and 74 percent for the low line. The response to selection in the high line has great economic importance.

A study of the birds in the low line shows general lack of viability, and specific causes of embryonic death remain to be determined.

—*F. A. Hays.*

Problems in Breeding for High Fecundity. Rhode Island Reds have been pedigree bred for high fecundity at the Station since 1916. As the level of production rises, more attention is given to viability as a vital factor. Evidence of overdominance has not appeared in this flock as far as present studies have gone. A line made up by random matings was started this year. Crossing this strain with White Leghorn males has given a marked stimulation to egg production. The F_1 hybrids averaged 264 eggs as compared with 240 eggs for the Station Reds. Viability was also higher in the hybrids. Strain crosses are now being studied. A very superior Rhode Island Red strain was chosen to cross reciprocally with Station Reds.

The method of feeding these experimental birds has remained constant for about 25 years, being free-choice self-feeding. Beginning January 1, 1953, 30-percent protein laying mash has been self-fed constantly, but the grain mixture has been restricted by hand-feeding in late afternoon. The effect of method of feeding on egg production is being studied in our closed flock.

—*F. A. Hays.*

Certain Factors Affecting Fertility in the Turkey. As part of a study on the poor reproductive efficiency of the turkey, an investigation was undertaken to determine whether any relationships exist between infertility and frequency of mating, proportion of matings successfully completed, distribution of mating, broodiness, egg production, and environment. Observations on the mating activity of Jersey Buff turkeys were made daily except Sunday from January 29 to June 8, 1952. Two of the factors studied, the frequency with which a hen mated and the proportion of total matings participated in by a hen and successfully completed were significantly correlated ($P > .01$) with apparent infertility. The incidence of broodiness, number of eggs laid, and environmental temperature did not appear to exert a marked influence on fertility in the population studied. The female was observed to be responsible for initiating matings, whereas the successful completion of available matings depended on the males. Thus, two avenues for possible improvement in turkey fertility are apparent, namely the mating frequency of the hen and the mating efficiency of the tom. The possibility of improving these two components of fertility, thereby increasing the reproductive efficiency of the turkey, is being investigated further.

—*J. Robert Smyth, Jr.*

A Study of Certain Factors Affecting Fertility in the Turkey. A study was undertaken to determine whether any relationships exist between apparent infertility in the Jersey Buff turkey and frequency of mating, mating efficiency, distribution of mating, broodiness, egg production, and environment. Observations on mating activity were made daily except Sunday from January 29 to June 8, 1952. Two of

the factors studied, the frequency with which a hen mated and the proportion of total matings participated in by a hen were significantly correlated ($P > .01$) with apparent infertility. The female was observed to be responsible for initiating matings, whereas the successful completion of available matings depended on the males. The incidence of broodiness, number of eggs laid, and environmental temperature did not appear to exert an influence on fertility in the population studied.

It was also observed that it is necessary to see males actually in the act of mating before an estimate of their breeding value from the fertility standpoint can be made. All males in this study were acceptable in regard to physical balance, soundness of feet and hocks, and ability to move well on the ground. However, the percentage of matings attempted that were successfully completed varied from 44.3 to 87.5. Flock fertility could be raised considerably if males were pretested or carefully culled and replaced on the basis of their mating ability.

—*J. Robert Smyth, Jr., and A. T. Leighton, Jr.*

Hatchability During the First Two Months of Egg Production in the Domestic Fowl. Producers of broiler chicks with their year-round market start setting eggs from young pullets as soon as egg size is satisfactory. Until recent years desired egg size was rarely reached for several months following sexual maturity. Now, certain meat strains whose first eggs are large enough for incubation have been developed. However, some field reports have indicated that the reproductive efficiency of pullets during this period is low. To investigate this problem, hatchability data during the two-month period after the onset of egg production were collected from 700 New Hampshire pullets at Nichols' Poultry Farm, Kingston, New Hampshire, and from 300 White Rocks, 50 White Leghorns, and 50 New Hampshire pullets at the University of Massachusetts. It was found that hatchability during the early reproductive period was 10 to 15 percent lower than it is after the birds have been in production for several months. This reduction in hatchability was found in the egg production White Leghorn and dual purpose White Rocks as well as in the meat strains. The reduced reproductive efficiency could be accounted for largely in each strain by an increase in the proportion of embryos dying during the first week of incubation.

—*J. Robert Smyth, Jr., Fred P. Jeffrey, and Herbert C. Hutchings.*

The Genetics of the Length of the Incubation Period in the Chicken. Continued progress was made in the third generation of selection to develop two lines genetically different in the length of their incubation periods. The mean emergence time difference between the lines was increased from the previous year's 12.4 hours to 20.4 hours. The latest selection generation had an average hatching time of 21 days and 3.5 hours for the early line and 21 days and 23.9 hours for the late line. The previously reported larger egg size of the late line in comparison to the early line was again reduced by concurrent selection so that the mean difference between the lines is now only 1.9 gm. Differences in the emergence time of full sib offspring

were not related to variations in the size of the eggs from which they hatched. This finding provided additional data to indicate that physiological factors that are independent of the physical size of the egg are involved.

—*J. Robert Smyth, Jr.*

Selection For Duration of Fertility in the Domestic Fowl. The length of time that sperm cells are able to remain functional after a single insemination is an important component of fertility in the domestic fowl. An attempt to learn something of the genetic basis for this problem is being made by selection for a long duration of fertility line and also for a short duration line. The complexity of the inheritance of this component was demonstrated by the fact that the third generation of selection showed that no appreciable progress had been made towards establishing high and low lines. Selection to date has been based on the female performance. However, the wide variation in duration of fertility between males and the relative consistency of individual males indicates that more attention should be paid to the male performance. It now appears that sperm survival time represents the composite distinct contribution of both male and female. The male contributes the sperm ability to survive in a given female environment. The female appears to contribute the specific female environment which varies in its conduciveness to support sperm life. This study would seem to have evolved into a selection experiment involving two distinctly different sex-limited factors, which together determine sperm survival time in the female reproductive tract.

—*J. Robert Smyth, Jr.*

DEPARTMENT OF SEED CONTROL

FREDERICK A. McLAUGHLIN IN CHARGE

During the fiscal year of 1953, 5634 samples of seed were tested at the Seed Laboratory. Of this number, 1501 were taken by an inspector from the stocks of seedsmen, in connection with enforcement of the Seed Law. The remaining 4133 service samples came from seedsmen, farmers, and State institutions. The laboratory also received and cleaned 51 lots of tobacco seed.

Analysis of inspection samples indicates that most seedsmen have complied with label requirements of the Seed Law. A large part of the violations are technical in nature rather than flagrant.

Operation of the Seed Law is reported in an annual Control Service bulletin issued for that purpose.

DEPARTMENT OF SHADE TREE LABORATORIES

MALCOLM A. McKENZIE IN CHARGE

General Program. From examination of approximately 9000 specimens in laboratory and field tests, 52 diseases of 33 species of trees were identified. Demands for consultation on tree problems have continued at an accelerated pace in connection with new housing developments; maintenance of public shade trees; and conservation, public works, park and cemetery programs. In particular, tree damage has been common in connection with construction operations and changes of grade and water table. The transfer of Professor W. E. Tomlinson, Jr., in October, 1952, to the Cranberry Station at East Wareham left a vacancy that required adjustments, particularly in the program of Waltham Shade Tree Laboratory. Currently, Mr. Clifford S. Chater has been added to the staff at Waltham, and plans are underway to resume research and control activities that had temporarily been curtailed on insect and fungus pests of trees. At present, the most urgent program need of the Laboratories' program is expansion of the investigation of the oak wilt problem.

Dutch Elm Disease Control Testing. From June 1, 1952, to June 1, 1953, the Dutch elm disease was found in samples from 42 additional towns, making a cumulative total of 291 towns of 351 towns in Massachusetts involved since the disease was first known here (1941, Alford, Berkshire County). Summarily, in laboratory studies by means of tissue plantings in artificial culture media, the disease fungus, *Ceratostomella ulmi* (Schwarz) Buisman, has been isolated from 18,182 trees (June 1952-1953, 5075) in all 12 counties on the mainland, Dukes and Nantucket being reported as disease-free at present.

—*M. A. Mc Kenzie, D. H. Marsden, R. L. Coffin, Demaradzki, H. S. Clark, J. Maspero, J. G. Moline, and M. M. Hart.*

An Evaluation of Practical Efforts to Control Dutch Elm Disease. Recommendations for the control of any plant disease should stand the test of application under the practical limitations and difficulties of existing conditions. The practicability of controlling Dutch elm disease is being studied in several towns where variable factors may test the value of recommended procedures for combatting the disease. Censuses of roadside elms have been taken in six towns in which Dutch elm disease has been present for three to eight years and for which fairly complete records on disease incidence have been kept. One town, Easthampton, affords an example of the necessity for a sustained, disease-control program: for the first three years (1947-49) during which the recommended scouting and prompt removal of diseased trees were carried out, the number of roadside elms affected totaled 16. After two years (1950-51) of almost complete neglect the total number of diseased roadside elms increased to 122 (1952), that is, the annual average incidence of disease increased from 0.5 percent to 2.0 percent after a short lapse in control efforts. Finally, in 1952, interest in saving the elms was revived, and a practical sanitation and spray program reinstituted. Up until June 30, 1953, only six more roadside elms had been confirmed as affected with Dutch elm disease.

Another community under study, Old Deerfield, had a total elm population of approximately 1856 trees. Eight trees were found affected in 1951. Timely removal of these trees was not effected, and in 1952, 27 additional elms became diseased. In that year, however, all confirmed trees were removed promptly, and a foliage application of DDT was made. In the Spring of 1953, all the elms were sprayed again, and as of June 30, 1953, only one new case of Dutch elm disease was discovered in the community.

— *D. H. Marsden, H. S. Clark, J. S. Demaradzki, and J. Maspero.*

Spread of Dutch Elm Disease and other Tree Pests by Tornado From the standpoint of tree welfare, repercussions of the tornado may be a plague far beyond the immediate damage apparent now on trees. Bark beetles, which spread Dutch elm disease, were in flight at the time of the tornado and could have been blown for many miles by high winds. Also, dead branches harboring either or both the disease fungus and beetle breeding galleries could have been broken and blown long distances to relatively disease-free areas. Since the disease tends to build up locally from a single diseased tree or branch as a focal point, clean-up campaigns to remove and burn elm debris are urgent now. Besides the Dutch elm disease, spread of other tree diseases and insect pests may also be involved. A good sanitation program with special emphasis on pruning and burning all dead and dying elm wood could be a valuable aid to all local tree programs in the tornado area or outskirts.

—*M. A. Mc Kenzie.*

Oak Wilt. Identification of the disease is based on detection of symptomatic trees in the field, especially in surveys from aircraft. Presence of the disease fungus may be confirmed by laboratory tests. Direct spread of the disease is indicated as being accomplished by root grafts. Methods of long distance spread are not definitely established. With present knowledge, suggested control is limited to isolation of oak stands of infected trees by 1) killing disease-free oaks in immediately adjacent areas to break the continuity in disease spread; 2) removing dead and diseased oaks; and 3) by trenching around diseased trees or trees at limits of disease spread. No treatment to protect oaks against infection is known, and all species of oaks, and also somewhat similar trees, native to the 18 States now involved with the disease are susceptible. For Massachusetts, the nearest affected oaks known at present are in Central Pennsylvania. On the basis of these facts, early detection of possible diseased trees in Massachusetts is imperative in view of the value of oaks to the Commonwealth, and the strongest representations possible are urged to provide the facilities requested for this work. Detection of oak wilt is sometimes complicated by other fungus diseases or tree troubles that resemble oak wilt in some respects, but do not represent such a serious threat to oaks, property owners, and industries.

—*M. A. Mc Kenzie.*

Foliage Diseases. After the abnormally wet Spring of 1953, leaf diseases caused by fungi were common throughout the State and were the subject of many inquiries to the Laboratories. Anthracnose of white oaks was particularly abundant and severe, whereas the same disease on sycamores was much less damaging than in the previous season. Anthracnoses of maples and ash were common and widespread, and willow scab caused severe defoliation in many areas. Reports from the field indicate that Puratized Agricultural Spray may be used to advantage in controlling the further current development and spread of leaf diseases already present in a tree. This "post-infection" treatment is in contrast to the standard "pre-infection" protection afforded by a series of copper sprays, the first of which is applied before the leaf buds open, and may be of value where protective sprays have not been applied.

— *D. H. Marsden.*

Effect of Winter Applications of Salt to the Soil near Trees. Each year the tree officers and property owners continue to be concerned with the possible injury that the large amounts of salt applied to some roads and sidewalks may have on adjacent shade trees. Soil samples have been taken from several suspected areas and tested for salt content, but none has shown a sufficiently high salt analysis to warrant a diagnosis of salt injury to the trees. In the Fall of 1952, several areas were selected to test the effect of both sodium chloride and calcium chloride on trees. Rather heavy applications of salt were made once each week from December 10, 1952, to March 18, 1953.

On some sites the salt was applied directly to the soil over the root areas; in other places, the salt was applied to the road surface where run-off waters would carry the salt to the root areas. Seven species of trees were involved. Chemical tests made in May, 1953, indicated that the salt content of the soil had not increased measurably on some sites, whereas on others the salt content had increased from less than 10 p.p.m. before the salting to as much as 700 p.p.m. However, no injury was noticeable on any of the trees as of June 30, 1953. It is thought that the abnormally high rainfall in the Spring of 1953 may have prevented injury by leaching the salt from the root areas. This experiment will be continued.

— *D. H. Marsden, H. S. Clark, J. S. Demaradzki, and J. Maspero.*

Natural Gas Injury to Trees. The advent of natural gas in many cities and towns of Massachusetts changes the complexion of the old problem of leaking gas injuring trees. Natural gas, being of quite different composition from manufactured gases, is known to be less toxic to vegetation both in the air and in the soil. Nevertheless, injuries to trees and other vegetation caused by natural gas escaping into the soil do occur, as experiences in other parts of the United States have shown. Recent limited surveys in Massachusetts where natural gas has replaced manufactured gas indicate that the problem of gas injury to trees may be alleviated in one sense but intensified in another. Trees will not be seriously injured immediately by small leaks because

of the relatively low toxicity of the gas itself, although large leaks, or leaks of long standing, which result in the displacement of air in a considerable volume of soil around roots, will kill or injure trees through root suffocation. On the other hand, it appears that the number of leaks may increase as the natural gas dries out the caulking in the pipe joints. This situation was exemplified in one Massachusetts city where a survey disclosed 86 leaks to have developed between June 1952 and June 1953, as compared to seven leaks which a survey disclosed for the previous year. Twenty-four trees were involved in these 86 leak-locations; three of these trees were being killed by widespreading leaks, whereas 21 trees in the immediate vicinity of small leaks showed no symptoms of gas injury at the time of examination.

— *D. H. Marsden.*

Tornado Tree Damage. The destruction of trees in certain parts of Central and Eastern Massachusetts on June 9, 1953, from storms accompanied by wind of such strong velocity and violence so rare in Massachusetts, exceeded previous records of storm damage to trees in the area.

In the Worcester area, havoc and destruction were widespread, even though the short duration of the extremely high winds, reported to have reached 500 miles per hour, was indicated as only approximately 5 minutes. Chiefly in a narrow band of relatively low terrain, more than 90 persons lost their lives chiefly because they were unable to find or seek suitable shelter promptly. Housing facilities of hundreds of people were demolished, along with valuable religious, educational, and other private and public property. Some industrial and agricultural activities together with public utilities suffered crippling losses. Fortunately, losses in all categories were held to a minimum by the smooth functioning of civilian defense organizations.

In a survey of trees, all types in the path of devastation were damaged without any significant differences in survival attributable to species. Individual trees as large as 65 feet in height and 3 feet in diameter were completely uprooted, although uprooting was not the principal characteristic on trees in the wake of the tornado. More common was the loosened bark, removed or clinging to trunks and branches following wrenching and twisting of limbs. Maples, oaks, and elms were observed with mangled or shattered crowns or limbs. Ornamental beeches were left leafless and disfigured, and foliage of other surviving shade trees was commonly shredded or mottled. Evergreens suffered varying degrees of breakage but generally they were left in their locations as ornamentals in a tilted position.

From the standpoint of a salvage program, trees fall into three general classes: 1. Shattered trees that are hazardous or beyond treatment and should be removed.

2. Specimen trees especially valuable to landscape design of property, or street trees that suffered major injury but can be restored by proper pruning, cabling or other treatment.

3. Trees that have been damaged to a lesser extent and need only guying (evergreens), routine pruning or painting of wounds.

In determining where individual trees fit into such a pattern, certain guide signs are already apparent. After only one month, some trees have shown evidence of new growth, and this feature may assist in selecting trees for salvage.

—*M. A. Mc Kenzie.*

Experiments on Control of Insect Infestations and Fungus Diseases. Eastern spruce gall aphid, *Chermes abietis* L. Dormant applications of 2 percent superior oil (Pratt), 1 pound of 25 percent wettable lindane powder and 2 pounds of 12 percent wettable benzene hexachloride powder in 100 gallons of water all gave 100 percent control of eastern spruce gall aphids on Norway spruce at Waltham in 1952.

Elm leaf miner, *Fenusa ulmi* (Sund.). Prior to any evidence of egg laying by the elm leaf miner, English elms were sprayed on May 16 with 2 pounds of 50 percent wettable DDT and 2 pounds of 50 percent wettable methoxychlor in 100 gallons of water. When the trees were examined on May 28 the leaves were found to be mined as extensively as leaves on near-by unsprayed check trees. The DDT plot was resprayed with 1 pound of 25 percent wettable lindane in 100 gallons of water on May 29. On June 12 an examination of the plot sprayed with lindane showed nearly perfect control of the miner in the leaves.

Cherry and hawthorn sawfly leaf miner, *Profenusa canadensis* (Mar.). On May 27, hawthorn trees were sprayed at a time when a few larvae had hatched, but the mines were still small. Materials used were 25 percent wettable lindane at 1 pound, 12 percent wettable BHC at 2 pounds, 25 percent wettable aldrin at 2 and 4 pounds, and 25 percent wettable dieldrin at 2 and 4 pounds per 100 gallons. None of the sprays were effective for controlling the hatched larvae. The infestation was less than on near-by check trees, however, indicating kill of eggs. With better timing it is probable that all these materials would be effective.

Sycamore lacebug, *Corythucha ciliata* (Say). Sycamores were sprayed with 1 pound of 25 percent wettable lindane and 2 pounds of 50 percent wettable methoxychlor per 100 gallons of water on May 16, May 28, and June 5. The lindane-sprayed trees were completely free of lacebug on June 18, whereas the methoxychlor–sprayed trees were no better than near-by unsprayed check trees.

Inkberry leafminer, *Phytomyza* spp. Inkberry plants in the nursery row were sprayed with 25 percent aldrin and dieldrin as follows:

Aldrin 1 and 2 pounds per 100 gallons { May 29, June 9 and 23 / June 9 and 23 / June 23

Dieldrin 1 and 2 pounds per 100 gallons—May 29, June 9 and 23

Dieldrin 1 pound per 100 gallons { June 9 and 23 / June 23

Aldrin 18 percent Emulsion 1 pint/100 —May 29, June 9 and 23

Aldrin 18 percent Emulsion 1 quart/100—May 29, June 9 and 23

No mined leaves were found in any of the sprayed plots when examined on July 17 and October 8, 1952. Mined leaves were common in the plants of the unsprayed check plots on July 17. Because mined inkberry leaves drop prematurely, mined leaves were not common even in the check plots on October 8.

More study of the biology and clarification of the identity of this leafminer should be made. It is closely related to the holly leafminer and possibly may attack holly. And, in turn, inkberry may be attacked by the holly leafminer when the two hosts grow in proximity to each other.

Solitary oak leafminer, *Cameraria hamadryadella* (Clem.). White oaks were sprayed on May 28 and June 5 with 2 pounds 25 percent wettable aldrin, 2 pounds 25 percent wettable dieldrin, 1 pound 25 percent lindane and 2 pounds 50 percent methoxychlor per 100 gallons combined with different fungicides. On June 18, mines were plentiful on the methoxychlor–sprayed and on unsprayed check trees. The aldrin, dieldrin, and lindane–sprayed trees were free of miner.

Spruce mite, *Paratetranychus ununguis* (Jac.). Arborvitae, heavily infested with spruce mites, were sprayed on June 13 with 50 percent Ovotran 2 pounds per 100 gallons, 15 percent Aramite, 2 pounds per 100, Aramex 25 percent emulsion 1-800, 25 percent Ovotran emulsion 1-800, and a combination of the Aramite and Ovotran emulsion at 1-1600 for each. More than 99 percent of the mites were killed by all the treatments according to counts made on June 28, and no build-up of mites occurred for the remainder of the summer according to counts made periodically throughout the summer and early fall.

A hemlock hedge, heavily infested with spruce mites, was sprayed on June 27 with 2 pounds of 50 percent Ovotran and with 1 pint of Ovotran emulsion per 100 gallons of water. Mite control was excellent with no build-up for the remainder of the season.

Holly mite, *Paratetranychus ilicis* (McG.). Japanese holly was sprayed on May 29 with 2 pounds of 15 percent wettable Aramite per 100 gallons for a heavy infestation of holly mite. A complete kill was obtained with no build-up of mite for the remainder of the season.

Boxwood mite, *Paratetranychus* sp. Boxwood plants in nursery rows, heavily infested with mites were sprayed on July 23 with 1 and 1 ½ pounds of 50 percent wettable Ovotran powder, 25 percent Ovotran emulsion at ½ pint plus 25 percent Aramex emulsion ½ pint, and with 50 percent Ovotran wettable powder 1 pound, plus 15 percent wettable Aramite 1 pound, each in 100 gallons of water. Excellent control of the mites was obtained with no injury to the box plants in any of the plots.

Elm leaf beetle, *Galerucella xanthomelaena* (Schr.). On June 18 when the first feeding of the young elm leaf beetle larvae was noticed, elm trees were sprayed with 2 pounds of 50 percent wettable methoxychlor, 2 pounds 50 percent wettable DDT, 2 quarts of a 25 percent methoxychlor emulsion, and with 1 ½ quarts of a DDT emulsion of 32.8 percent DDT, 58.4 percent xylene, 2.12 percent Triton X-100 and 6.7 percent acetone per 100 gallons of water. There was no further larval feeding on any of the sprayed trees, but near-by unsprayed trees were severely browned by larval feeding later in the season.

Cankerworms, *Alsophila pometaria* (Harr.) and *Paleacrita vernata* (Peck). A mixed stand of elm, maple, oak, and birch heavily infested with cankerworm larvae was sprayed in late May with 1 ½ quarts per 100 gallons of water of the DDT, xylene, Triton, acetone mixture discussed under elm leaf beetle. Excellent control of the worms was obtained.

Oak Lecanium, *Lecanium* sp. A large white oak tree heavily infested with Lecanium scale crawlers was sprayed in early June with 1 ½ pounds of 15 percent wettable Parathion per 100 gallons of water. Control of the scale was close to 100 percent.

Hawthorn leaf blight, *Entomosporium* sp. Dormant applications of Fixed Copper, Fermate, Dithane (D-14 plus ferric sulfate and D-14 plus zinc sulfate), Dithane Z-78, Vancide 51 liquid-sticker, and Vancide 51 powder plus sticker. A dormant application was made May first followed by further applications on May 13 and May 27 using 1 ½ to 2 pounds of each material per 100 gallons of water in combination with the insecticides previously listed. Sixteen different varieties of Crataegus were treated (about 50 trees) at Peter's Hill, Arnold Arboretum—too few individual trees for good replication. Control of the leaf spot was apparent in all cases where the controls exhibited any symptoms. Because Fixed Copper burned the leaves in the early applications, it is not recommended.

Sycamore anthracnose of London plane. Delayed dormant application of 1 ½ to 2 pounds per 100 gallons of water of Dithane (D-14 plus ferric sulfate) and Vancide 51 powder plus sticker in combination with Lindane and Marlate, or with Marlate alone, for lacebug was made May 2 and repeated May 16 and 26. Inasmuch as development of anthracnose was very slight on any of the trees in the experiment (9 trees 25 to 45 feet tall), the results are inconclusive. No evidence of phytotoxicity or incompatibility of the chemicals was seen.

White oak anthracnose. A delayed dormant application of 1 ½ to 2 pounds per 100 gallons of water of Fixed Copper, Dithane Z-78, and Vancide 51 powder and sticker was made May 7 and followed on May 16, 28, and June 5 on a group of two dozen white oaks. The fungicides were combined with the insecticides mentioned previously. Control results were inconclusive, because little anthracnose appeared in this stand of oaks. Inasmuch as the early application of Fixed Copper burned the leaves, this fungicide is not recommended for early season applications to white oak. No other phytotoxicity was noted, and no incompatibility was observed among the chemicals tested.

—*W. E. Tomlinson, Jr., P. L. Rusden.*

DEPARTMENT OF VETERINARY SCIENCE

K. L. BULLIS IN CHARGE

Poultry Disease Control Service.

1. *Pullorum Disease Eradication.* During the 1952-53 testing season 1,168,739 blood samples, collected from 371 flocks, were tested for pullorum disease. This represented a slight decrease in comparison with the number of flocks and samples tested the previous season. The percentage of positive tests (0.04) was also slightly greater than that of the previous season. Of the total birds tested, 99.27 percent were in nonreacting flocks. Reactors were detected in nine flocks, of which seven had been negative two or more years previously. The number of breaks was slightly greater than the number detected the previous season. No reactors were detected in 35,135 tested fowl other than chickens. The testing results will be reported in more detail in the Thirty-third Annual Report of Pullorum Disease Eradication in Massachusetts.

2. *Poultry Disease Diagnostic Service.* The primary purpose of the two diagnostic laboratories is to aid members of the poultry industry by furnishing accurate and complete diagnosis of disease outbreaks, to recommend appropriate treatment when indicated, and to encourage management practices that will minimize disease problems. An opportunity is also afforded to gauge the effectiveness of recommended control measures, to judge the needs and objectives for allied research, and to study health problems as they occur under natural conditions. Again in 1952 (as in 1951) the volume of diagnostic work exceeded that of any previous year.

AMHERST. During the calendar year 4,202 specimens were submitted for examination in 955 consignments. The specimens were classified as follows: 3,821 chickens; 205 turkeys; 22 each of canaries and swine; 20 rabbits; 19 pheasants; 16 pigeons; 13 chinchillas; 10 each of ox, goat, and horse specimens; 7 sheep; 4 each of ducks and cats; 3 each of dogs, robins, and squirrels; 2 guinea fowl; 1 each of bluejay, deer, dog food, mink, mourning dove, otter, budgerigar, and ruffed grouse. The most prevalent chicken diseases identified were chronic respiratory disease (141), infectious bronchitis (140), Newcastle disease (129), unidentified respiratory infections (90), coccidiosis (65), and fowl paralysis (42).

WALTHA. During the calendar year, 8,632 specimens were submitted for examination in 1,548 consignments. The specimens were classified as follows: 7,492 chickens; 1,022 turkeys; 35 pheasants; 24 pigeons; 17 ducks; 13 rabbits; 12 budgerigars; 6 canaries; 4 geese; 2 parrots; and 1 each of chinchilla, guinea fowl, monkey, peafowl, and ruffed grouse. The most prevalent chicken diseases identified were infectious bronchitis (171), coccidiosis (156), lymphocytoma (123), Newcastle disease (110), fowl paralysis, (95), capillaarisis (86), unidentified respiratory infections (77), and chronic respiratory disease (58). The most prevalent turkey diseases identified were coccidiosis (26), erysipelas (19), enterohepatitis (10), and fowl cholera (9).

3. *Poultry Bronchitis Control.* During the 1952 calendar year 1,077 flocks, representing 2,464,401 birds, were enrolled in the bron-

chitis control program. In the flocks enrolled, 1,512 inoculations were made. Positive takes were observed after 1,034 inoculations, whereas no reaction was reported in 239 instances. Seventy-four flocks were reinoculated with 21 manifesting definite takes. Two hundred ninety-seven flocks inoculated in 1951 were not enrolled in 1952. In general the results were very satisfactory for all flocks inoculated. In a few instances excessive losses were reported. It is recognized that this program has certain limitations and that improvements will result from further research work. However, in the meantime the flock owners have a method that will aid in the prevention of losses from infectious bronchitis.

Also, during the past calendar year 116 flocks were tested for their immunity to infectious bronchitis with the following results: 75 were immune, 22 nonimmune, 8 questionable, and 11 immune and nonimmune. Among the 359 flocks tested for immunity to Newcastle disease, 103 were immune, 206 nonimmune, 7 questionable, and 43 immune and nonimmune.

4. *Chronic Respiratory Disease.* During the 1952 calendar year, virus isolations from field cases yielded the following results: chronic respiratory disease (CRD) agent (129), infectious sinusitis (1), infectious bronchitis (2), Newcastle disease (3), infectious coryza (1), infectious laryngotracheitis (1), canary pox (2), and unidentified and negative cases (26).

Chronic respiratory disease continues to be an economic problem to the poultry industry. Results of investigations during the past year reveal that chickens surviving an outbreak of the disease may become carriers of the infection. Furthermore, chickens that have recovered from the disease possess a moderate degree of refractivity to reinfection with the CRD agent. Among the different antibiotics (aureomycin, bacitracin, chloromycetin, magnamycin, streptomycin, and terramycin) tested, none were found to be effective in controlling the disease in experimentally inoculated chickens and turkeys. Para-amino-benzoic acid also was found ineffective. Embryo studies and propagation of the agent on artificial media were continued during the year, and the results substantiated previous findings. Infectivity tests in other hosts revealed the guinea fowl to be susceptible and the cotton rat refractory to the agent.

—*H. Van Roekel, G. H. Snoeyenbos, G. P. Faddoul, Jack E. Gray, M. K. Clarke, O. M. Olesiuk, Joseph E. Gray, N. Shipkowitz, G. W. Fellows, R. A. Bennett, C. F. Smyser, Jr., and L. P. Beninato.*

Newcastle Disease Immunization Studies. Field studies of Newcastle vaccination by spraying a commercially prepared, dried vaccine containing the B_1 strain of virus were carried out during the past year. The vaccine was administered to birds 3 to 20 weeks of age, spraying the vaccine over the heads of the birds in an enclosed house or range shelter. Most of the flocks were sprayed with a DeVilbiss nasal atomizer at the rate of 20 ml. of vaccine per 1000 square feet. This method was equally effective whether used as the initial vaccination or for revaccination. Respiratory symptoms on occasion were quite pro-

nounced, but paralytic symptoms were absent. Mortality as a rule was negligible, but was increased to one or two percent in some of the younger flocks.

It has been found that the virus concentration of the vaccine, the quantity administered, and the particle size of the spray are interrelated factors in obtaining a satisfactory immune response. A vaccine of relatively low virus concentration will give satisfactory protection if dispersed as a very fine spray, whereas the same amount is ineffective as a coarse spray.

Immunity tests and absence of Newcastle disease in flocks so vaccinated indicate that the spray method of vaccination gives satisfactory protection.

—S. B. Hitchner and G. Reising.

Mastitis Testing Laboratory. Laboratory testing is essential to effective control of mastitis, which seriously affects the economics of the dairy enterprise. It is particularly needed in the eradication of *Streptococcus agalactiae* infection and is of great value also in the selection of replacement cows, determining the cause of flare-ups, and checking on the results of treatment. Gains are reflected by increased milk production, reduced treatment expense, reduced replacement costs, and improved quality of milk. Additional benefits are associated with improved management practices promoted by the testing program.

During the calendar year of 1952, 32,308 milk samples were tested. Of this number, 21,380 were from 18 State institution herds, 1,035 from the University Farm Department herd, and 9,907 from 92 private herds. Included in the latter were 592 samples from two county agricultural school herds, 12 from three goat herds, and 2,672 from nine demonstration herds.

The incidence of *Streptococcus agalactiae* infection in the 18 State institution herds was compared with that of the preceding year. A reduction from 39.8 percent of the cows to 10 percent was revealed in the nine infected herds, although none of the herds became entirely free from the infection.

A study was made to determine the effect of collection of samples for mastitis testing on milk production in the University Farm Department herd. Samples were collected at the regular milking time just prior to the attachment of the milking machine. Production was not below normal during the period from collection day to four days after collection. It was concluded that the collection from this herd causes no decrease in production when samples are drawn as described.

—W. K. Harris and I. M. Reynolds.

A Study of the *In Vitro* Effect of Certain Antibacterial Agents on *Pseudomonas aeruginosa* Isolated from Bovine Mastitis.

A satisfactory treatment of the increasingly common *Pseudomonas* infections of the udder has not yet been found. The *in vitro* effectiveness of certain antibiotics alone and in combination with each other and with certain chemical dyes has been studied and evaluated. A combination of brilliant green and polymyxin B sulfate was shown to

exert a greater ihnibiting effect on the *Pseudomonas* strains tested than did either drug alone. A clinical trial with this combination for *Pseudomonas* mastitis seems warranted.

—W. K. Harris in cooperation with R. B. Czarnecki and A. I. Aronson, Department of Bacteriology.

PUBLICATIONS

Research in Review. Vol. 2, No. 1. January 1953.
Research in Review. Vol. 2, No. 2. June 1953.

BULLETINS

467 Annual Report for the Fiscal Year Ending June 30, 1952. 96 pp. March 1953.
468 Histological Studies of the Bovine Uterus, Placenta, and Corpus Luteum. Richard C. Foley and Ralph P. Reece. 64 pp. June 1953.
470 Prices and Milksheds of Northeastern Markets. Northeast Regional Publication No. 9. William Bredo and Anthony S. Rojko. 103 pp. August 1952.
472 Marketing Massachusetts Potatoes. Part II. The Enterprise in Transition. Robert A. Fitzpatrick. 24 pp. June 1953.

Control Bulletins

152 Thirty-second Annual Report of Pullorum Disease Eradication in Massachusetts. Poultry Disease Control Laboratory. 12 pp. July 1952.
153 Inspection of Commercial Feedstuffs. Feed Control Service Staff. 26 pp. July 1952.
154 Inspection of Commercial Fertilizers and Agricultural Lime Products. Fertilizer Control Service Staff. 16 pp. August 1952.
155 Seed Inspection. Seed Control Service Staff. 28 pp. December 1952.

Meteorological Bulletins

763-774 Monthly reports of daily weather records, including monthly and annual summaries. R. K. Patterson and I. J. Pflug. 4 pp. each.

Reports of Investigations in Journals

812 A survey of the incidence of antigenic forms of *salmonella pullorum* in the U.S. G. H. Snoeyenbos, B. Bachman, and H. Van Roekel. Poultry Sci. 31(6):1009-1016. November 1952.
813 Frenching of ragweed (*Ambrosia artemisiifolia* L.). L. S. Jones. Plant Phys. 28(1):123-126. January 1953.
822 Cancelled.
824 Detergents and septic tanks. J. E. Fuller. Sewage and Industrial Wastes 24(7):844-850. July 1952.
825 How much quaternary gets into milk? Carry-over when teat cups are dipped in solution before each cow is milked is not sufficient to delay acid development, researcher finds. W. S. Mueller. Amer. Milk Rev. 14(3):42, 95. March 1952.

826 Malic acid–fructose reaction. G. E. Livingston. Jour. Amer. Chem. Soc. 75(6):1342-1344. March 1953.

827 Modification of Norman-Jenkins method for determination of cellulose. E. Bennett. Analytical Chem. 24(9):1510-1511. September 1952.

828 Possible effects of sex-linked genes on reproduction and fecundity in Rhode Island Reds. F. A. Hays. Poultry Sci. 31(5):826-829. September 1952.

830 Pasteurized fresh whole pickles. III. Heat penetration in fresh whole pickles. W. B. Esselen, I. S. Fagerson, I. J. Pflug, and E. E. Anderson. The Glass Packer 31(3):175-178, 201. March 1953.

831 Pasteurized fresh whole pickles. V. Factors influencing pasteurization requirements. W. B. Esselen, E. E. Anderson, I. S. Fagerson, and M. Labbee. The Glass Packer 31(5):326-327, 346-347. May 1952.

833 Pasteurized fresh whole pickles. IV. Enzymes and off-flavor in fresh pack pickles. M. Labbee, W. B. Esselen, and E. E. Anderson. The Glass Packer 31(4):252-253, 281-282. April 1952.

834 An egg-propagated immunizing agent for the control of infectious bronchitis of chickens. C. D. Brandt, H. Van Roekel, and H. A. Peck. Poultry Sci. 31(6):1004-1008. November 1952.

835 The influence of chemical thinning treatments on yield and flowering of apples. F. W. Southwick and W. D. Weeks. Proc. Amer. Soc. Hort. Sci. 60:165-172. December 1952.

836 Ascorbic acid in tocopherol-enriched milk. A. D. Holmes. Food Res. 17(4):367-369. July-August 1952.

837 Effects of treating cuttings of woody plants with both a root-inducing substance and a fungicide. W. L. Doran. Proc. Amer. Soc. Hort. Sci. 60:487-491. December 1952.

838 Effects of age at sexual maturity on body weight, egg weight, and egg production. F. A. Hays. Poultry Sci. 31(6):1050-1054. November 1952.

841 The effect of rates and sources of nitrogen, phosphorus, and potassium on the mineral composition of McIntosh foliage and fruit color. W. D. Weeks, F. W. Southwick, M. Drake, and J. E. Steckel. Proc. Amer. Soc. Hort. Sci. 60:11-21. December 1952.

844 Flock vaccination for Newcastle disease by atomization of the B_1 strain of virus. S. B. Hitchner and G. Reising. "Proceedings Book," Amer. Vet. Med. Assoc., 89th Ann. Meeting, Atlantic City, pp. 258-264. June 23-26, 1952.

845 Air conditions in and near farm buildings. E. F. Cox. Agr. Eng. 33(8):495-496. August 1952.

846 The effect of essential oils on the inhibition and thermal resistance of microorganisms in acid food products. E. E. Anderson, W. B. Esselen, and A. R. Handleman. Food Res. 18(1):40-47. January-February 1953.

847 Chronic respiratory disease of chickens. H. Van Roekel and O. M. Olesiuk. "Proceedings Book," Amer. Vet. Med. Assoc., 89th Ann. Meeting, Atlantic City, pp. 271-275. June 23-26, 1952.

848 Pasteurization of genuine dill pickles. W. B. Esselen and E. E. Anderson. The Glass Packer 31(9):600, 603. September 1952.

849 Meat content varies in frozen shrimp packages. I. S. Fagerson, E. E. Anderson, and C. R. Fellers. Quick Frozen Foods, pp. 51, 125. October 1952.

851 Antibiotics and lactic acid starter cultures. E. I. Stoltz and D. J. Hankinson. Jour. Applied Microbiol. 1(1):24-29. January 1953.

852 Some common noninfectious diseases of shade and ornamental trees in New England. D. H. Marsden. Proc. 28th Natl. Shade Tree Conference. August 1952.

855 Storage life of mature and immature Butternut squashes. A. D. Holmes. Jour. Amer. Dietet. Assoc. 29(2):140, 141. February 1953.

858 Value of nitrogen for stabilizing reduced ascorbic acid in milk. A. D. Holmes. Food Tech. 7(3):136-137. March 1953.

861 Effects of intense ultrasonic vibrations on *Pisum*. I. Effects on root meristems. J. L. Spencer. Growth 16:243-254. December 1952.

862 Effects of intense ultrasonic vibrations on *Pisum*. II. Effects on growth and their inheritance. J. L. Spencer. Growth 16:255-277. December 1952.

863 Chemical composition of weeds and accompanying crop plants. J. Vengris, M. Drake, W. G. Colby, and J. A. Bart. Agronomy Jour. 45(5):213-218. May 1953.

866 Sugar and acids in grass silage. J. G. Archibald. Jour. Dairy Sci. 36(4):385-390. April 1953.

867 The occurrence of trimethylamine and trimethylamine oxide in fresh water fishes. D. W. Anderson, Jr., and C. R. Fellers. Food Res. 17(6):472-474. November-December 1952.

868 Yield and vegetative and chemical composition of forage crops as affected by soil treatment. J. L. Parsons, M. Drake, and W. G. Colby. Soil Sci. Proc. 17(1):42-46. January 1953.

871 Dutch elm disease: An evaluation of practical control efforts. D. H. Marsden. Plant Disease Reporter 37(1):3-6. January 1953.

872 Chickweed control in grass-legume seedings by preplanting applications of calcium cyanamid. J. Vengris. W. G. Colby, and M. Drake. Proc. 7th Ann. Meeting, Northeastern Weed Control Conference, New York City, pp. 199-203. January 7-9, 1953.

878 Ascorbic acid retention in frozen concentrated and canned juices. E. E. Anderson, I. S. Fagerson, and C. R. Fellers. Quick Frozen Foods 15(8):171-175, 352. March 1953.

880 Development and application of an apparatus for study of thermal resistance of bacterial spores and thiamine at temperatures above 250°F. I. J. Pflug and W. B. Esselen. Food Tech. 7(6):237-241. June 1953.

882 Nutritive requirements of acetobacter. I. Vitamin requirements of *acetobacter xylinum*. W. Litsky, W. B. Esselen, B. S. Tepper, and G. Miller. Food Res. 18(3):250-252. May-June 1953.

885 Discussion on cranberry bog irrigation. C. E. Cross. Cranberries. 17(10):7, 8. February 1953.

Miscellaneous

Another attack on the replacement problem. B. D. Crossmon. Dairy Digest. University of Massachusetts. July 1952.

Reappeared as: Feeding to speed the breeding will pay. Purina Eastern Dairy Letter. October 1952.

Pride goeth before a fall. B. D. Crossmon. Farm Econ. Facts. University of Massachusetts. August 1952.
Reappeared: Farm Policy Forum, Iowa State College Press. October 1952.

Blister rust damage at Waterford, Vt. P. L. Rusden. Jour. For. 50(7):545-551. July 1952.

Phooey on Mr. Newlon, too. B. D. Crossmon. (Analytical critique.) Poultry Digest. Garden State Press, N. J. August 1952.

Some infectious shade tree diseases common to Eastern Massachusetts. P. L. Rusden. Proc. 28th Natl. Shade Tree Conference, pp. 79-84. August 1952.

Some insect pests of New England trees. W. E. Tomlinson, Jr. Proc. 28th Natl. Shade Tree Conference, pp. 85-88. August 1952.

Table-top ultraviolet chamber for the study of chromatograms. G. E. Livingston, D. E. Westcott, and I. S. Fagerson. Chemist Analyst 41(3):68-69. September 1952.

Cranberry trash is useful. F. B. Chandler. Cranberries. October 1952.

Sex dimorphism in tail length of chicks at ten days of age. F. A. Hays. Poultry Sci. 31(6):1093. November 1952.

Sex ratio in Rhode Island Red chicks at hatching. F. A. Hays. Poultry Sci. 31(6):1050-1054. November 1952.

Suggestions for storing carnation cuttings. J. W. Mastalerz. Mass. Flower Growers Assoc. Bul. 16:4. 1952.

Are the green pasture winners good farmers? B. D. Crossmon. New England Homestead. January 24, 1953.

Outline of seasonal control of Dutch elm disease and some other elm pests in Western Massachusetts. M. A. McKenzie, D. H. Marsden, A. I. Bourne, and W. B. Becker. Mimeo. Western Mass. Tree Wardens' and Moth Supts.' Assoc. March 1953.

Culling for slaughter vs. holding borderline cows. B. D. Crossmon. Dairy Digest. University of Massachusetts. March-April 1953.
Reappeared: Farm Econ. Facts, University of Massachusetts. June 1953.

Dutch elm disease eradication unlikely. D. H. Marsden. Sci. News Letter. 63(16):249. April 18, 1953.

More layers, same space, less feed per dozen eggs seen with leghorn cross. B. D. Crossmon. Worcester County Farmer. April 1953.
Reappeared as: More dollars from lighter hens? New England Homestead. April 25, 1953.

Incidence of forage crop pests in Massachusetts with notes on seasonal history of the meadow spittlebug. A. I. Bourne, F. R. Shaw, and W. Boyd. Jour. Econ. Ent. 46(1):159. May 1953.

Economic study of fruit farm organization underway. R. O. Aines. Fruit Notes, University of Massachusetts. June 1953.

Pathology in forest practice. M. A. McKenzie. (Book review.) Garden Jour. of N. Y. Botanical Garden 3(3):95,98. May-June 1953.

Three progress reports (the Dutch elm disease). M. A. McKenzie. Mimeo. September 1952-June 1953.

Fusicoccum peach canker. E. F. Guba. Mass. Fruit Growers Assoc. Annual Report. 59:69-71. 1953.

How a tree grows. T. T. Kozlowski. Trees Mag. 13 (3) :6-7;22-23. 1953.
Low-temperature dry-conditioning of carnation flowers and cuttings. J. W. Mastalerz. Carnation Chats 1(10) :3-5. 1953.
Low-temperature dry-conditioning of cut flowers. J. W. Mastalerz. The Maine Leaf 3:1-2. 1953.
Basic information for snapdragon production. J. W. Mastalerz. The Maine Leaf 3:2-4. 1953.
Peach canker caused by the fungus *Fusicoccum persicae* E. & E. E. F. Guba. (Abstract) Phytopath. 43:109. February 1953.
Red forcing tomatoes resistant and immune to *Cladosporium fulvum* Cke. E. F. Guba. (Abstract) Phytopath. 43:109. February 1953.
Results of experiments and lessons from 1952 on fruit disease control and spray injury. E. F. Guba. Mass. Fruit Growers Assoc. Annual Report 59:66-69. 1953.

Publication of This Document Approved by George J. Cronin State Purchasing Agent
1m—11-53—910980